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THE ANNUAL CONVENTION OF THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

The twenty-eighth annual convention of the American Institute of Electrical Engineers, which was held in Chicago last week, was a great success. In point of attendance it surpassed all previous conventions of the Institute, the registration being about 950. The arrangements were very complete and left nothing to be desired for the satisfactory and convenient carrying out of the program, for which great credit is due the Convention Committee. The entertainment features were also well planned and were greatly enjoyed by those present.

The announcement of the resignation of Secretary Ralph W. Pope will be received with regret by all members of the Institute. Fitting resolutions were adopted during the convention expressing the appreciation of the members for the twenty-six years of service which Mr. Pope has rendered. The resignation goes into effect August 1, after which date Mr. Pope will act as honorary secretary, devoting his attention mainly to section work.

The present convention marked the first return in several years to a large city as a place of meeting, and the desirability of this is a point upon which considerable difference of opinion prevails. The accessibility of a city like Chicago adds greatly to the attendance, and consequently to the percentage of membership which is directly benefited by the holding of the convention. The proximity of industrial establishments also makes possible the arrangement of interesting excursions of inspection to these plants. On the other hand, it must be admitted that the holding of a convention at a summer resort results in a closer commingling of the members in attendance and in less distraction from the primary purposes of the convention. The holding of the convention in the Middle West cannot be regarded other than as a very desirable move on the part of the Institute which is fittingly testified by the success of the present convention.

The program at the convention was decidedly overcrowded and an improvement in this feature seems both possible and very desirable for future conventions. The number of papers presented was entirely too great and, considering their general mediocrity, almost inexcusable. A large number of the papers presented could have been omitted without detracting from the success of the convention. It was

apparent at most of the sessions that there was insufficient time for the proper presentation of the papers, and in many cases discussion had to be limited, notwithstanding the length of the sessions. The great disadvantage of an incomplete presentation of a paper is emphasized when, as at the present convention, a large number of the papers were not printed sufficiently in advance to permit of their reading by the members before starting for the convention. This, be it understood, is not due to any delay in the secretary's office, where some admirable work was done this year in rushing papers into print, but the trouble lies in the late receipt of the papers at that office. An obvious remedy for this condition, especially where there is an abundance of papers, lies in excluding from the program every paper which is not submitted in ample time. It would seem that the rule requiring papers to be submitted to a committee before acceptance should be enforced, with very good results, instead of being held for the mere purpose of constituting an easy barrier for the rejection of those papers which the committee considers undesirable.

In spite of the average mediocrity of the papers presented there were a number of individual papers which were of high quality and of great interest. The papers by Messrs. Schuchardt and Schweitzer at the opening session commanded the attention of all interested in central-station operation and presented results which are of great importance. The desirability of inserting limiting reactances in the connections to high-power generators was ably demonstrated by these experiments, and this will probably lead to an important step in general practice.

The session devoted to the railway committee was the liveliest at the convention, the subject being evidently one of not only general but of deep interest. While the discussion was intense, it was unfortunately more of a personal than technical nature and little was brought out in regard to the development of electrification other than that the single-phase system may be considered an operating success and has taken its place with the direct-current system as one of the standard modes of operation. The desirability of one system or another cannot be stated in general, but must depend upon local conditions.

Two papers presented at the session on high-tension transmission were noteworthy as presenting an advance in our knowledge of the electric strength of air and the phenomena of corona. The problem of corona loss may be considered to be solved and the information now available is sufficient to determine when such loss will occur and what its magnitude will be under any specified conditions. The design of extra-high-tension transmission lines may be proceeded with, with the assurance that for any definite conditions of operation the results may be predetermined.

The meeting of the section delegates on Thursday evening disclosed considerable dissatisfaction with the method in vogue for carrying on elections and with the electioneering which was such a prominent feature of the last presidential contest. A long discussion of these matters made it apparent that little was to be gained by any amendment to the constitution or by-laws relating to the method of holding elections and that the causes of dissatisfaction were really inherent in the natural conditions. The Board of Directors has done all in its power to carry out the wishes of the membership in this matter and to secure a wide geographical representation upon the board. This free and frank discussion between the various delegates and some of the board members has done much to dispel the dissatisfaction and it is not likely that any radical steps will be taken in regard to this matter.

One of the important features of the convention season was the dinner given by Mr. H. M. Byllesby, when a number of the leading financial and business men of Chicago were brought together with the leaders among the engineers of the United States. The luncheon tendered the Institute by the Electric Club of Chicago was a success beyond the expectations of the most sanguine, and was in fact one of the most delightful affairs of the entertainment program.

QUANTITATIVE INVESTIGATIONS IN TELEGRAPHY.

The attention now being given to quantitative investigations in telegraphic circles is a most encouraging feature of modern signaling practice. The papers of Mr. Fowle before the American Institute of Electrical Engineers and before the Association of Railway Telegraph Engineers at the recent Boston convention illustrate to a marked degree the possibilities of scientific measurement and calculation when applied to the problems of telegraphic transmission. In the telephone field, the paper of Mr. Gherardi shows in a similar manner the importance of measurements in relation to the quality of service demanded under present conditions of long-distance messages.

At the Boston meeting in particular, an interesting quantitative demonstration was effected by the exhibition in one of the sessions of an artificial telegraph line having an electric length of 500 miles, and the illustration of Mr. Fowle's paper on "Line Conductor Requirements for Telegraph Transmission" by this equipment was one of the hits of the convention. Following a somewhat extended theoretical discussion of the characteristics of a line 500 miles long, the author illustrated the effect of changes in insulation resistance upon the current flowing and upon the character of the signals transmitted, the measurements upon the artificial line checking easily within about one per cent of the theoretical values. The line was constructed in order to demonstrate the theory of leakage and especially to show the possibility of employing wires of high resistance for long lines under conditions of high insulation. The artificial line had a wire resistance of ten ohms per mile and an insulation resistance per mile of 0.25 megohm. In order to make it approximate closely to a corresponding actual line, whose resistance, leakage and capacity are uniformly

distributed, it was divided into twenty sections, each 25 miles in length. The sections were joined together in series and arranged with cut-in jacks, so that various lengths less than 500 miles could be secured for experiment. A leak resistance was provided for the equivalent of a given insulation resistance in megohms, 10,000 ohms being used in place of 0.25 megohm per mile, for a 25-mile section. By throwing a switch an additional leak resistance of 16,670 ohms could be inserted, making the total 26,670 ohms, or the equivalent of 0.667 megohm per mile. A small amount of capacity was also provided, to offset the nominal inductance present in such a line.

By means of this artificial line the effect of changing the insulation resistance was demonstrated, with the result that successful transmission was increased from a range of from practically 300 to 500 miles, with fixed terminal conditions. The impossibility of working the line to its full length in face of adverse insulation-resistance conditions was plainly demonstrated, and the whole apparatus was easily set upon two tables of moderate size, and supplied with current from a lamp outlet connected to a small motor-generator set. The value of such investigations need not be discussed at length, but they indicate the tendency of electrical engineers specializing in signaling work to adopt accurate quantitative methods of attack on the elusive problems which surround telephone and telegraph circuits. In commercial power transmission, efficiency is clearly important on the ground of the high cost of wasted energy. In telegraphy and telephony, clearness of transmission is equally vital, and, although clearness cannot be expressed in physical units, it is of great interest to the art that it can be promoted by the accurate study of operative conditions from the instrumental and quantitative standpoints.

THE TRIUMPH OF THE BOSTON & EASTERN.

Friends of high-speed electric railroading will welcome the news that the Governor of Massachusetts has signed an act giving a certificate of exigency to the Boston & Eastern Electric Railroad Company, which has for several years been seeking the right to build a fast third-rail interurban road between Beverly, Salem, Lynn and Boston, Mass. Press dispatches state that the promoters of the company encountered more opposition from the established transportation systems than has ever before been experienced in efforts to plan a new and progressive system of transit. The steam roads and local trolley lines have fought the project tooth and nail by every means known to modern massed capital, but the essential need of the road was long ago demonstrated, and the weight of public opinion was too strong to be permanently resisted. The backers of the project now have an opportunity to show what electricity can do under the most favorable conditions of installation, and from the preliminary plans which have from time to time been made public and discussed by engineers of national reputation, we have little doubt that the passage of the law over the heads of the Board of Railroad Commissioners will within a few years result in a complete revolution of transit facilities in the northeastern part of the State of Massachusetts.

FREE FAN SERVICE FOR INVALIDS.

Recent advices from DeKalb, Ill., state that the DeKalb-Sycamore Electric Company will furnish free fan service to any sick person upon the recommendation of the attending physician, and if the house is not wired the company will run service wires and install sufficient interior wiring to operate the fans, loaning the latter as long as may be required. Similar action has also recently been authorized by H. M. Byllesby & Company for all of its electric properties throughout the country.

Fan service for the sick in the hot months is often practically a necessity, always a help, and frequently those who need it most cannot afford it and are unwilling to ask or accept financial aid. In fact, in the case of the Byllesby properties free fan service is only extended to those financially unable otherwise to secure the same.

It is not, then, any definite idea of benefit to the companies that prompted these commendable measures. The keynote of the situation is admirably expressed in a communication from Mr. A. Norman, general manager of the DeKalb Company, who states that in making this offer the company had in mind only the general idea that a public-service corporation owes a duty to the public which it cannot fully discharge without providing that particular emergency service for the needy which, by virtue of its monopoly, it only is able to supply. Mr. Norman also states his abiding faith in the ultimate good to the corporation that recognizes its duty to the public and faithfully tries to discharge it.

A realization of these theories by every central-station company would result in ideal conditions. These are the underlying principles which prompt the far-seeing students of central-station affairs to present the many able papers on "Public Policy" before the conventions of the various central-station associations.

Of course equitable rates, prompt attention to complaints, courtesy on the part of employees, etc., are all vitally necessary and make for desirable conditions in central-station relations. But it is acts like that above mentioned which call forth the admiration of the entire public, customers and non-customers alike, and establishes the central station in the position of a respected utility company, which, although as it should be, is nevertheless very uncommon.

Also, while of secondary importance, direct benefits follow. By assisting physicians, charitable organizations and others in the care of the sick, the central-station company comes in personal contact with the city's most influential citizens and a relationship is established which can be productive of excellent results.

New York State Street Railway Convention.

The twenty-ninth annual meeting of the Street Railway Association of the State of New York was held at Cooperstown, N. Y., on June 27 and 28. The papers of electrical interest presented at this meeting were "The Edison-Beach Storage Battery Car," by Ralph H. Beach, of the Federal Storage Battery Car, New York; "Gas-Electric Motor Cars," by W. B. Potter, chief engineer of the railway and traction department General Electric Company, Schenectady, N. Y.; "Steps in the Solution of the Problem of Adequately Controlling Electrically Propelled Vehicles," by W. V. Turner, chief engineer, Westinghouse Air Brake Company, Pittsburg, Pa.; and a committee report on the joint use of poles by lighting, power, telephone and electric-railway companies.

Mr. Beach said that the Edison nickel-iron oxide battery is superior to lead batteries for traction purposes, owing to its stability under great variations in temperature and in charging and discharging. The fact that it could be charged at ten times the normal rate without injury was most valuable in railway service where maximum car mileage was an essential or where the lay-over periods were short. Furthermore, the ability to discharge rapidly was invaluable during acceleration periods or when operating on severe grades. Mr. Beach mentioned installations in Washington, D. C., and Concord, N. C., where the cars are charged during three-minute and ten-minute lay-overs, respectively. The Washington car operates over a four-mile line in sixteen minutes and runs 204 miles a day.

The energy consumption of the Edison-Beach cars was much lower, due partly to their very light weight and partly to the use of anti-friction bearings. The weight reduction is attained principally by employing all-welded truck and body framing and by eliminating body end doors on vestibuled cars. The roof is also much lighter, since the trolley base and pole, which require heavy stiffening members, are absent.

The efficiency of the battery and the anti-friction bearings is so high that a double truck car required only 49.63 watt-hours per ton-mile when running at a maximum speed of twenty-five miles an hour and a schedule speed of eighteen miles an hour over a distance of 70.2 miles. This energy consumption is one-half to one-third of that required by a standard type of double-truck trolley car under similar conditions. The great reduction in weight appears from the fact that the double-truck car weighs 600 pounds per seated passenger whereas the lightest double-truck trolley car weighs 750 pounds, while some of the Chicago cars weigh over 1,200 pounds. This record is all the more remarkable as sixty pounds of battery are required per passenger. Mr. Beach advocated his car not only as a substitute for the overhead and conduit current-collection systems, but also suggested its use as a rush-hour auxiliary on present lines where such cars could be charged before the usual peak-hour loads came on.

In the discussion following his paper, Mr. Beach added that the effieiency of the battery at normal charging and discharging rates is 61.2 per cent and that the battery is most efficient up to three-fifths of its rated output. The voltage of the cells dropped very slowly until 0.8 of the rated capacity was reached. No improvements had been found necessary in the chemical features of the battery, but its internal resistance had been greatly lowered by reducing from one-fourth inch to one-eighth inch the diameter of the positive tubes.

Mr. Potter offered the gas-electric motor cars of the General Electric Company as a substitute self-propelled vehicle for the unprofitable traffic branches of steam railroads and for proposed roads where the probable business would not justify the erection of an overhead trolley. A mechanical gasoline drive was undesirable for railway cars because a large number of speed changes would subject the engine and driving mechanism to a severe strain, due to the mechanical shocks which resulted from the use of a clutch. By employing electric drive, the gasoline engine could be operated constantly at its most efficient speed, while the speed of the traction apparatus could be changed with the most desirable nicety by varying the voltage of the generator in combination with the series-parallel connection of the motors. Mr. Potter presented the following operating costs per car-mile for cars weighing from 40 tons to 50 tons and using from 0.5 gallon to 0.7 gallon per mile: Engineer, conductor, cleaning, $0.07; gasoline, $0.05; supplies, $0.01; maintenance of car body and trucks, $0.01; maintenance of engine and electrical equipment, $0.03; making a total of $0.17.

The largest cars of this type are seventy feet long and ten feet five inches over all. They have a maximum speed of about fifty miles an hour and a schedule speed of twenty-five miles an hour, with stops 2.5 miles apart.

Mr. Turner reviewed the history of air-brake development and then gave a detailed account of the Westinghouse electro-pneumatic brake recently adopted for the subway service of the Interborough Rapid Transit Company, New York. This equipment consists of a quick-action, quick-recharge, quick-service graduated release, automatic air brake with twenty-per-cent higher pressure in emergency application, combined with electrically-controlled means of simultaneously admitting air directly to or releasing it directly from the air-brake cylinders without any movement of the triple valves. An absolutely simultaneous movement of the triple valves of the train to emergency position is obtained by electricity.

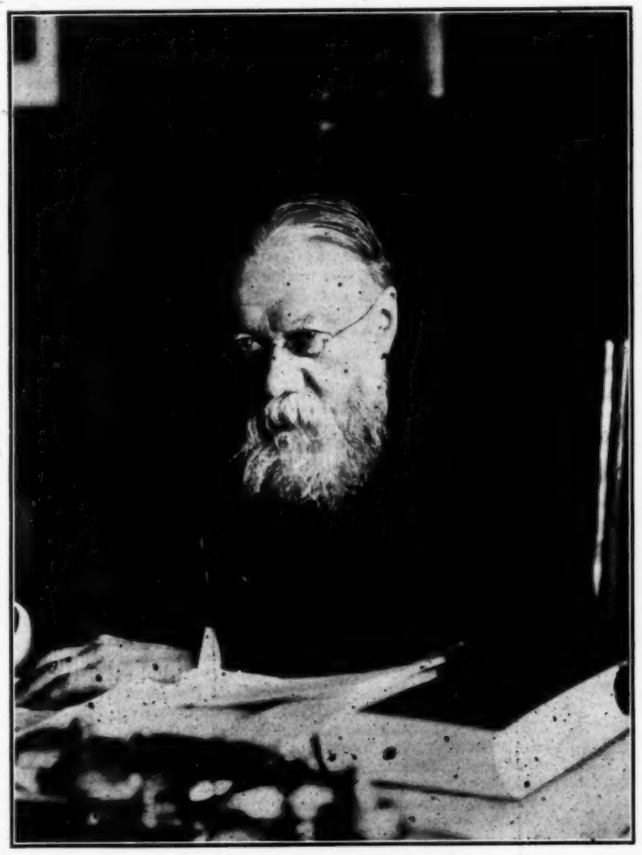
The report of the Committee on Joint Use of Poles was prepared after conference with representatives of the National Electric Light Association, New York Telephone Company and the Public Service Commission of the Second District, New York. It differs in some respects from the standard joint-pole agreement of the National Electric Light Association in placing greater stress upon the rights of electric railways. The report has been printed and can be obtained upon application to the secretary of the Street Railway Association, J. C. Collins, New York State Railways, Rochester, N. Y.

The feature of the banquet on Tuesday evening, June 28, was an address by Oscar T. Crosby, president Wilmington & Philadelphia Traction Company, and one of the pioneers in the electric railway field who were associated with Frank J. Sprague. Mr. Crosby said that the great problems before electric railways were financial now instead of technical. The principal one was what constituted a reasonable return on the investment. It could not be denied that the government had the right to regulate public utility corporations and to limit even their rate of return. However, this regulation should not be carried so far as to frighten progressive men of small means.

Sir William Henry Preece.

Gauged by the evidences of his intellect, by the great range of information which he has contributed to the enrichment of the scientific records of the world, Sir William Henry Preece towers among the men of science of the present age as a man of magnificent achievement.

Sir William H. Preece was born February 15, 1834, near Carnarvon, "the capital of North Wales," and is the eldest son of R. M. Preece, Bryn Helen, Carnarvon. He was married in 1864 to Agnes, daughter of the late George Pocock of Southampton, who died in 1874 leaving four sons and three daughters.



SIR WILLIAM HENRY PREECE,
Engineer, Inventor, Author.

After completing a full course at King's College, London, and studying electricity under Faraday at the Royal Institution, he entered in 1852, the office of the late Edwin Clark, engineer-in-chief of the Electric Telegraph Company, and when two years later the latter was incorporated with the International Telegraph Company under the name of The Electric & International Telegraph Company, then presided over by Robert Stephenson, he was given quite a prominent position which led, during 1856, to his promotion as superintendent of that company's southern district. This was followed, four years later, by his appointment to the superintendency of the London & Southern Railway, which he continued to hold up to 1870, when all the telegraph companies were transferred to the Post-Office Department. Mr. Preece had by this time established such a reputation for unflinching industry and had shown such ability in carrying out the very important work entrusted to him, that the Post-Office Telegraph Department tendered him the position of divisional engineer for its entire southern district. This, he accepted, with headquarters at Southampton, making himself still more valuable in the new position which brought with it still greater responsibilities. He succeeded in materially improving the service by adapting several of the devices for which patents had already been granted him and richly merited the promotions that were in store for him. After seven years of this work, he was advanced to the post of electrician to the entire system, which necessitated his return to London, where, five years later (1892), he became the engineer-in-chief. He so continued till 1899, when he resigned to become consulting engineer of the Post-Office Department, finally resigning from active service when he reached the age of seventy, during the year 1904. Before joining the Post-Office Department, he was called upon to act as consulting engineer to the Channel Islands Telegraph Company (1858-1862) and later was permitted to make several voyages in behalf of the Government. On one occasion, he brought a set of the first electric bells from Paris to London; and, when, at the Philadelphia Centennial Exhibition in 1876, the telephone was introduced by Alexander Graham Bell, this startling invention drew him as it did many others, and he went to the United States. There, he obtained many new electrical contrivances and was enabled to procure and bring back with him, amongst other apparatus, the first pair of telephone receivers seen in England.

His inventions include a new telephone, improvements in the Wheatstone apparatus and in duplex, quadruplex and multiplex telegraphy, also new systems of wireless and of "terminating" wires; and, in particular, many new electric devices for the increased safety of railway travelling. The latter embrace apparatus for block signaling, for signal-locking, for signaling between passengers and guard from different parts of moving trains, also for working miniature electric signals to assimilate and combine them with outdoor signals, and he is likewise the inventor of the method for counteracting the interference caused to electric signals by lightning.

He is the author of a "Manual of Telegraphy," of "The Telephone" and of a "Manual of Telephony," all of them written in conjunction, respectively, with Sir James Sivewright, Dr. Julius Maier and A. J. Stubbs. He has, besides, been a most prolific writer of scientific papers.

Among the distinctions conferred upon Sir William Preece is the decoration of Officer of the Legion of Honor, given him at the Paris Exposition of 1889. He was made a C. B. in 1894, and a K. C. B. in 1899. He entered the Institute of Civil Engineers (British) in 1852, became associate in 1859, member, 1872, and, after serving a long time on the council and also as vice-president, was elected president in 1898. He was, likewise, twice president of the Institution (British) of Electrical Engineers (in 1880 and 1893), also president of Section G of the British Association at the Bath meeting, and president of the Carnarvon branch of the National Service League, and he was chairman of the council of the Society of Arts. He is a Fellow of the Royal Society, member of the Physical Society, Meteorological Society, Royal Institution, and of many similar organizations.

American Institute of Electrical Engineers.

Annual Convention Held in Chicago, June 26 to 30, 1911.

The twenty-eighth annual convention of the American Institute of Electrical Engineers was held in Chicago, June 26 to 30. From every standpoint the convention was unquestionably the most successful so far held in the history of the Institute. The final registration was somewhat over 950.

The spacious meeting hall in the Hotel Sherman was taxed to its capacity when President Dugald C. Jackson called the meeting to order shortly after 10 a. m. on Tuesday morning, June 27. Past President Louis A. Ferguson, chairman of the Convention Committee, was then introduced. Following a brief talk, in which Mr. Ferguson outlined some of the features planned for the convention, President Jackson introduced Maclay Hoyne, representative of the City of Chicago, who warmly welcomed the delegates to the city. President Jackson then delivered the annual address, an abstract of which appeared in our last issue.

Gano Dunn, president-elect of the Institute, was then introduced and in a very fitting and sincere address thanked the members for the honor they conferred upon him in electing him to what he considers the highest honor attainable by an electrical engineer. He said that this act on the part of the Institute has called forth the best that is in him and his one aim will be to conduct the affairs of the American Institute of Electrical Engineers as the members would have them conducted.

After calling upon Secretary Pope for several announcements relative to the entertainment features for the day, the regular program of papers was taken up. President Jackson reversed the order of the program, and the paper by R. F. Schuchardt and E. O. Schweitzer entitled, "The Use of Power Limiting Reactances with Large Turbo-Alternators" was then presented by the former, following which the paper by E. B. Merriam entitled "Tests of Oil Circuit Breakers" and the paper by C. P. Steinmetz entitled "Development of the Modern Central Station" were presented, the discussion being deferred until all three had been read. The paper by Dr. Steinmetz, in slightly condensed form, appeared in our last issue.

THE USE OF POWER LIMITING REACTANCES WITH LARGE TURBO-ALTERNATORS.

This paper discussed at the outset the development of the modern central station and the tendency to an increased severity in the disturbances due to apparatus and cable breakdowns with the growth of the stations, apparently due to the increase in generator capacity. The absolute necessity for reducing the current which can flow into a fault is now clear. As this current is a function of the reactance of the circuit it is apparent that the reactance must be increased. The transformers can be rewound so as to give an internal reactance of approximately four and one-half per cent. An additional amount could be added externally. In the case of the generators the higher value of reactance could, of course, be taken care of in the new designs. In the new units of very large capacity it was thought best to divide the desired total reactance between the generator itself, winding it for comparatively low voltage, and an auto-transformer which would serve to step up the voltage to the required value. The major duty of withstanding the shocks caused by system disturbances was thus placed on a device external to the generator. The paper describes the reactance, the apparatus tested, the tests, and gives a very interesting and complete analysis of the observations made in the form of tables and oscilligraph curves. The conclusions from these tests indicate that the instantaneous short-circuit current of these generators is actually not as high as has been thought, but that this current, due to its comparatively high power-factor, produces severe stresses on the generator and seriously strains the oil-switches. In order to reduce the severity of these strains it is desirable to have a higher value of reactance in the generator circuit than many of these large-capacity generators have been designed for. In the case of the 12,000-kilowatt, 9,000-volt, 750-revolutions-per-minute, twenty-five-cycle unit it appears that an external reactance of approximately six per cent is desirable. Such reactance will limit the current to a value where it can be safely interrupted by properly designed oil-switches. The use of reactances tends to make the operation of the system as a whole more stable.

OIL CIRCUIT-BREAKERS.

These tests were made through the courtesy of the management of the Commonwealth Edison Company, of Chicago, using a three-phase, 12,000-kilowatt, 9,000-volt, twenty-five-cycle turbo-generator. The apparatus tested included three current-limiting reactances; one standard triple-pole, type F, Form H-3, oil circuit-breaker; two special triple-pole, type F, Form H-3, oil circuit-breakers; one standard triple-pole, type F, Form H-6, oil circuit-breaker; three standard single-pole, type F, Form K-2, oil circuit-breakers; one special triple-pole, type F, Form K-12, oil circuit-breaker, and three special single-pole, type F, Form K-12, oil circuit-breakers. Practically all of the tests were either three-phase or single-phase short-circuits, some to ground and some between phases. The paper gives a close analysis of all the observations and performances during the tests, use being made of two three-element electro-magnetic oscillographs, one three-element arc length recorder, special spark gaps, a special gas engine indicator, movement-recording devices, etc. Respecting the effect of short-circuit on the generator it was observed that the field current of the alternator rose when the armature was short circuited to values as high as ten times the field current at rated no-load voltage of the alternator. It was also noted during this series of tests that spits of fire came out of the alternator field. In some of the single-phase tests, and also in some of the tests where the short-circuit was thrown on by three single-pole circuit-breakers, it was noticed that the voltage of the phase not short circuited rose to a very high value, sometimes as high as two and one-half times normal. The current-limiting reactances consisted of seventy-six turns of 1,000,000 circular-mill copper cable wound on a cement core, and supported by a wooden frame-work. Each coil was made up in three layers. The result was a cement-cored reactance having no iron in or about it. The terminals were brought out at the top and bottom. It was found in the generator under test that the introduction of six-per-cent reactance in each phase halved the maximum instantaneous current and reduced the torque on the turbine shaft to about one-seventh of what it would have been without the reactance. The reactance also maintained the terminal voltage of the alternator when a short-circuit was thrown on a system beyond the reactance, and permitted the generator to recover its normal voltage after a short-circuit had been removed much more rapidly than would have been the case had the short-circuit been placed directly across its terminals. In the tests of the oil circuit-breakers it was noted that at times some oil was thrown out of the oil vessels. By suitable baffling the energy imparted to the oil by the expansion and explosion of the gases generated in the oil vessels was absorbed, and the operation of the circuit-breaking devices materially improved and its rupturing capacity increased. It was also found possible to separate the gases from the oil, thereby permitting the gases to escape into the air and the oil to be retained in the oil vessels. The larger oil vessels of the H-6 form were of greater assistance in opening a circuit. The results show that the stress developed in the ten-inch diameter oil vessel is only one-third to one-fifth of that developed in an eight-inch diameter oil vessel of the H-3 form. It was found by diminishing the velocity with which the contacts parted there was more disturbance, and the rupturing-capacity of the device was greatly diminished.

The discussion was opened by John W. Lieb, Jr., of New York, who said that the points brought out in Mr. Steinmetz's paper are of vital interest and should be given deep consideration. Referring to Mr. Schuchardt's paper Mr. Lieb said that with the concentration of power-generating sources as exemplified by the Commonwealth Edison Company's system the dependence of the Company's customers makes it essential to protect against disturbances and irregularities of operation. With the elements brought out in the paper understood by central-station operators, guarantee of service may be safely made.

M. H. Collbohm regretted that tests had not been made on horizontal-break oil switches. He called attention to the characteristics of this type of instrument and added that the knife blade insures a more reliable contact.

David B. Rushmore spoke of the magnitude of present systems, and of the apparatus used in some of the larger stations. He stated that he looks forward to stations of very much larger size in the future and in designing apparatus for these, external reactances make for simplicity. He said that automatic reactances that vary with the current are needed.

Charles W. Stone said that the question was raised as to the ultimate capacity of oil switches. He thought that by the use of reactances a new design of switch is not needed as it as it is still possible to increase the ultimate capacity of stations using the present types. He said that the thanks of the Institute are due the Commonwealth Edison Company for carrying on such exhaustive tests as are outlined in Mr. Schuchardt's paper. Referring to Mr. Collbohm's argument in favor of the horizontal-break switch, Mr. Stone said that he evidently has lost sight of the fundamental principle of the vertical-break switch which in his opinion has much higher capacity than the latter. Speaking of reactances, Mr. Stone expressed the opinion that generators will have a higher factor of safety with external reactances. He said that the fact brought out that no damage resulted to the machines tested after repeated short-circuits emphasizes the value of reactances.

B. G. Lamme said that in high-speed machines internal reactances give no difficulty and are preferable to external reactances. He thought that if the reactances cannot conveniently be installed inside the machine, they should be placed outside. He also referred to tests that were made with both types and stated that reactances which will limit the short-circuit current to twelve times its full current are needed.

Charles F. Scott mentioned only the topics of a written discussion sent by W. L. Waters. The principal points taken up are choke coils, reactances and oil switches.

Louis A. Ferguson asked Mr. Lamme whether he advised placing the reactance inside of large machines. In answer Mr. Lamme said that it was largely a question of conditions, but that in large machines he would favor putting as high a reactance as possible in the machine.

In concluding the discussion Mr. Schuchardt stated that all delegates who participated in the inspection trip to the Edison Company's stations would see the machine upon which the tests were conducted and the apparatus used.

Dr. Steinmetz in closing said that the oil circuit-breaker is the instrument least understood by engineers. The operation is based on the control of the explosive forces at the break. The eccentric gun-type switch has many advantages not found in others. He thought that the question of internal vs. external reactances was simply one of design and that power-limiting reactances on the busbars are of greater importance. The danger of operation does not increase with the extension of the system.

Public Service Session.

The meeting of the Electric Lighting Committee was held on Tuesday evening, the session being called to order at about 9:00 o'clock. President Jackson called upon H. M. Byllesby to present his address entitled "The Responsibility of Electrical Engineers in Making Appraisals."

MAKING APPRAISALS.

Mr. Byllesby reviewed briefly the remarkable developments which had taken place in the electrical industry during the last thirty years. These accomplishments make up a record of which the annals of civilization probably do not contain a parallel. Along with the feeling of well merited pride that the engineer and the inventor might have, however, we should not forget something without which it could not have taken place. This has been the work of the promoter and the banker. No new industry can be established, nor when established can continue, and no art can grow to the dimensions of the electrical industry, without the continued presence of the individual who supplies the money to the inventor and the engineer. The achievements of the electrical engineer would not have been possible if it had not been for the presence of the men with money who believed in the commercial possibilities of the art as from time to time developed, and have produced the capital with which to continue the development. Many worthy inventions and developments have attracted no great notice, have not accomplished their destiny, because of the absence of the man, or corporation, with both faith in the invention and the means of producing the capital to develop it. The electrical profession has been fortunate in having had associated with it from its inception men who were sufficiently intelligent, courageous and farsighted to see the merit of the inventions and developments which from time to time were produced, and who had the faith withal and the ability to continue to stand behind these inventions and developments with their capital during those periods when the inventions were under criticism, temporary failure and disappointment very often being the only result achieved. While this period was attended with heart-breaking anxieties to the inventor and the engineer it must not be forgotten that it was also a period of heart-breaking anxiety and disappointment to the men who had invested their capital in these things. Today there is a great deal of discussion regarding the value of a franchise, the privileges it affords, and the obligations it carries. If those who probably with the best intentions are criticizing these matters had gone through the experience of the earlier days they would change their opinions. If a careful and unprejudiced study were made of the history of the early electric light, trolley and water-power companies it would be impossible to escape from the conviction that the persistence and courage of the promoter and capitalist who carried them through their early period of disaster and lack of credit is quite as notable an achievement as that of the inventors and engineers who produced the physical and scientific part of these enterprises. The enterprise and courage of the men and the corporations fostering these developments has given a superior service at a less cost than in any other country. The liberal franchise grants issued in the past and the freedom from onerous restrictions with a broad and liberal construction thereof, has justified the issuance of stock which eventually would pay to the promoter and projector of these enterprises when they became successful something in addition and beyond a fair interest return on their investment. Without these features this development with its low charge to the public would not have taken place. The communities where at present there is no paying return upon the investment are served with commodities at as low a cost as communities more thickly populated. The corporations serving these communities have heretofore been justified in providing capital and extending their plants into non-productive fields. Both the public and corporations are now reaching a common meeting ground requiring public-service corporations to be protected and regulated monopolies. With this doctrine the public-service engineer and operator have no quarrel. Public service commissions, however, should be composed of men of character, men of ability, men who have accomplished something in the world. Mr. Byllesby discussed at some length the question of the making of appraisals, and emphasized the necessity for the engineer making a very definite study of this phase of industrial economics. The public-service corporation is laboring under a considerable handicap when engineers time and again make an estimate as to the cost of building a plant which falls far short of the real cost of putting the plant into operation. In the making of appraisals we must avoid the fallacy that only the physical portion of a corporation's property is entitled to a value, the facts being that behind the naked physical value there is required a very large and material sum to change that naked, inert mass of physical construction into a live and progressive earning entity.

Immediately following Mr. Byllesby's address, President Jackson called upon Henry Floy to present his paper entitled "Depreciation as Related to Electrical Properties."

DEPRECIATION.

Mr. Floy discussed the application of terms defining depreciation, physical value, development expenses, intangible or overhead values, original cost, cost of reproducing new, or cost of reproduction, scrap value, wearing value, service value, present value, growing value, good will and franchises. This paper is a deeply intellectual study of the whole subject of depreciation as applied to electrical properties. The several methods of estimating depreciation are anayized and their characteristics indicated by the use of curves. There is also a comprehensive tabulation giving the approved rates used in estimating theoretical depreciation under a great many conditions.

The discussion on these two papers was opened by Bion J. Arnold, who said that he agreed with Mr. Byllesby and also with the spirit indicated in President Jackson's annual address, that the electrical engineer could perform no higher service than by becoming interested in the problems affecting the relations of public-service corporations with their customers. It was highly necessary that the mind of the public be made clear, or that the public be helped to make up its own mind, as to what is fair and reasonable in its attitude toward the service companies supplying so universally needed a commodity as electrical energy.

Distrust of some of the methods which had been practised by corporations in the past was warranted in many instances, but the public had not been fair in all cases. When the public did realize that it had a weapon with which to attack the corporations it went to the other extreme, but fortunately there were elements at work which speedily sought to educate the public to a better appreciation of the great benefits conferred upon the community by these corporations, and the situation now appears to be possible of a happy and satisfactory solution.

So far as franchise values were concerned, Mr. Arnold explained that in the pioneer days franchises had been secured very liberally and that in order in later years that the value of a property should more nearly represent the great expenditure that had been made in developing a hazardous investment it was necessary to give these franchises a value and include them in the appraisal of the existing properties. The corporation that developed the operating plant through the early vicissitudes was entitled to a more than reasonable return upon its investment or else it was entitled to live long enough and charge a high enough rate so that it could earn back all the money that had been put into development expense, in addition to the present value of the existing property. Where, however, the promise of the future was that there would be a ready market for the securities of public-service corporations and if the industry has become a settled and stable one, the corporations can no longer expect to make excessive profits.

W. F. Wells continued the discussion. He disagreed with the suggestion made in Mr. Floy's paper that only absolute values should be considered and he considered that theoretical depreciation, contrary to Mr. Floy's suggestion, had a definite and important place in the fixing of values. He also disapproved of the suggestion that a company maintaining its property in first-class condition should not be allowed a depreciation factor in establishing values for the creation of rates.

Mr. Wells gave some very interesting information respecting a system which had been employed by the Edison Electric Illuminating Company of Brooklyn. The Hollerith system of tabulation employed by the United States Government in analyzing the census returns had been adapted to the inventory of the underground system. Each street and all different material of construction were given specific key numbers which were utilized for perforating the cards for use in the adding machines. Something like 3,800 record sheets had been prepared involving the use of 36,000 cards. These cards were placed in the sorting machines and it was then simply a matter of manipulation to catalog every element in its proper relation. These cards and record sheets now form a permanent reference file, easy of access for the discovery of any information concerning the entire system.

John W. Lieb, Jr., said it was a matter of congratulation that two papers so widely afield from those usually presented to the Institute has been made available. As time goes on those responsible for the destinies of the large public-service corporations must come face to face with the problem of elucidating the data upon which was based the demand of the corporation for a reasonable return upon its development and maintenance costs. It was necessary, therefore, that there must be a fair and clear grasp of the situation, because it will be found impossible to make known adequately, the views upon which a fair hearing can be had through the medium of attorneys unfamiliar with technical requirements and with the terminology of the industry.

Mr. Lieb called attention to the necessity for careful and intelligent interpretation of tables of statistics relating to depreciation factors for various apparatus and materials of construction. In Mr. Floy's paper it was pointed out that the rate of depreciation for arc lamps was given as six per cent and a rate of six per cent was given also for the depreciation of meters. Mr. Lieb called attention to the inadequacy of this figure considering the rapid change which had come about in these two particular fields. He considered that the rapid journey from operating efficiency to the scrap heap should be recognized and recognized particularly by electrical engineers, as they had contributed very much to the condition which made this journey so hurried and so sure of consummation. Mr. Lieb indorsed Mr. Arnold's statement respecting the reasonable and proper provision for disappearing assets, and this was a point upon which the public was greatly misinformed. It was unfortunate that in the minds of so many what he considered disappearing assets were considered as "water." In consolidating a number of smaller companies into a large organization a great deal of the material of the smaller companies has been utterly unavailable to the larger organization and consequently much of what was tangible evidence of capitalization has been swept away. However, securities had been issued for this superseded material and operating system in good faith.

S. S. Wheeler suggested that while the important features of the papers under discussion related entirely to the appraisal of public-service corporations, he felt that there were many other investments which constituted electrical properties and it might be well for electrical engineers also to give their attention to this phase of the subject. He thought also that it would be better if the various and several kinds of depreciation were unified and only one rate of depreciation for each material were to be considered. He thought there was approximately a definite value of each piece of property at a definite time in its life, and he considered it proper, also, in the conduct of any business, that each year should be charged with a sum proportionate to the cost of maintaining the property during that period.

At the close of the discussion, Mr. Byllesby having retired, Mr. Floy was called upon to make some further remarks and he explained that in the tables given in his paper he had presumed that it was understood that they should be used only as an indication of what had been done. He thought that progress could be made only by reviewing carefully the developments of the past and that by analyzing the work of those who were now engaged in establishing methods of making appraisals it would be possible in the future to arrive more readily at the very valuable information that was necessary if the proper balance is to be struck between the corporations and their customers.

Railway Session.

In accordance with a previous arrangement, the meeting on Wednesday morning was called to order at 9:30 by President Jackson. At this session the order of the papers was also reversed and the discussion deferred until all had been presented.

The first paper was entitled "Induction Machines for Heavy Single-Phase Motor Service," by E. F. W. Alexanderson; the second entitled "Electrical Operation of the West Jersey & Sea Shore Railroad," by B. F. Wood; and the third entitled "Analysis of Electrification," by W. S. Murray.

INDUCTION MACHINES FOR HEAVY SINGLE-PHASE MOTOR SERVICE.

The experimental results and investigations presented in Mr. Alexanderson's paper have the object of showing the possibilities of operating polyphase motors from single-phase circuits, particularly with a view of the use of such a system where heavy starting duty is required. In introducing the subject Mr. Alexanderson stated that a well known scheme, often thought of in connection with changing single-phase currents to polyphase, is the use of an induction motor. Two terminals of the induction motor are connected to the single-phase line, whereas, all three terminals are connected to the driving motor. If the first mentioned machine, which may be classified as a phase converter, runs at full speed, it generates a polyphase voltage which is available for starting the driving motor. The scheme presented by the author is a development from the induction phase converter, with the introduction of such improvements that the starting torque of the main motors is the same as on polyphase current instead of less than one-half of that value. The result of the arrangement of the windings as outlined is that the current output of the phase converter is not demagnetizing, but tends to increase the voltage, and the voltage and current of the secondary phase can be entirely regulated by selection of a suitable voltage for interpolation between the windings. The value of the system for practical purposes can be demonstrated only by showing the proportions of apparatus such as would actually be used. Mr. Alexanderson states that the system appears particularly to advantage when one phase converter can be used to furnish power to an aggregate of several motors. For this purpose designs have been made of a phase converter of a capacity corresponding to 1,600 motor horsepower. Discussing the subject of relative proportions the author points out that with the type of machines which would actually be used, the weight of the phase converter is only from one-third to one-quarter of the aggregate weight of the driving motors. The converter being a machine running light on its shaft without carrying any mechanical load, can be designed for the most economical speed, and it appears that this would be a peripheral speed, which is twice as high as the peripheral speed of the motor. Furthermore, the weight per kilowatt is reduced because a single machine is used to serve an aggregate of several motors. For these reasons it is fair to assume that the active material in the phase converter is used at least twice as efficiently as the active material in the motors. Considering the electrical equipment as a unit there are some gains which partly offset the additional weight of the phase converter. With three-phase power the motors must be supplied from a three-phase transformer, whereas, if single-phase power and a phase converter is used, the three-phase transformer can be replaced by a single-phase transformer. The weight of a single-phase transformer is about two-thirds of the corresponding three-phase transformer, and the difference an appreciable part of the weight of the converter. Altogether it can be estimated that the total increase in weight of the electrical equipment for single-phase power will be fifteen per cent over the corresponding polyphase equipment with the same output and starting torque. A comparison of the phase converter with a motor-generator set of corresponding capacity gives another illustration of the merits of the system.

ELECTRICAL OPERATION OF THE WEST JERSEY AND SEA SHORE RAILROAD.

Mr. Wood's paper presents complete and comprehensive data on the electrical operation of the electrified portion of the West Jersey & Seashore Railroad. The direct-current over-running third-rail system operating at 675 volts is used. The paper describes the system, giving the mileage of section electrified, equipment of the power station, description of the transmission line, equipment of the various substations, descriptions of the rails, third-rail, rolling stock, etc. Exhaustive cost data is presented. The cost of construction of some of the more important features are as follows: power stations, $994,900; transmission line, $241,500; substations, $491,500; third rail, $557,636; cars, $1,135,900. The total cost of construction for electric features is $8,130,229. The unit cost of electrification was given as follows: power station, cost per kilowatt, $110.00; transmission line, cost per mile, $3,485.00; substations, buildings and equipment cost per kilowatt, $28.90; third rail, cost per mile, $4,235.00; overhead trolley, cost per mile, $4,120.00; track bonding, cost per mile, $684.50; and cars, including electrical equipment, each, $12,214.00. Tables are given showing cost of maintenance of all parts of the system, cost of renewals, etc.

ANALYSIS OF ELECTRIFICATION.

Mr. Murray explained that the object of his paper is to present experiences with single-phase electrification on the New York, New Haven & Hartford Railroad, which has passed through a period of five years' successful operation. In his introductory paragraphs Mr. Murray makes a strong plea for the single-phase system. The first part of the paper is taken up with a discussion of the four classes of steam locomotives, namely, the passenger express locomotive, the passenger local, the freight road engine and the freight switch engine. The author maintains that in order to replace these locomotives with electrics a study of their characteristics is necessary. The later pages are devoted to data on the electrified portion of the New Haven Road with detailed figures of cost and maintenance on the power house, locomotives, line construction and general features. Mr. Murray states that his experience with the single-phase system versus other competitive systems, affords him the conviction that, under practically all conditions of trunk-line consideration where the traffic is of the same amount and character, or indeed much less than that which is comprehended in the mileage that this paper covers, its first cost is at the greatest not more than eighty-five per cent of its next best competitor, and its operating costs less than the above percentage.

Before taking up the discussion of these papers, President Jackson appointed the following as a Committee on Resolutions: David B. Rushmore, Schenectady; Prof. Carl E. Magnuson, Seattle; and Prof. Alexander S. Langsdorf, St. Louis.

Frank J. Sprague, of New York, opened the discussion of the papers. In his introductory remarks, Mr. Sprague called attention to a peculiar coincidence in that in 1892, just nineteen years ago, in his inaugural address as president of the Institute, he prophesied the subsequent steps that have been taken towards electrification of trunk lines and anticipated the present development of the industry. Quoting from that address he mentioned that electrification would first be confined to city street-railway systems, later to connecting lines between these systems, then suburban systems, freight systems and finally trunk lines. Direct current was then the only system known but Mr. Sprague read a statement in which he recommended alternating current. He also referred to the multiple-unit system of control and paid a tribute to Chicago's engineers in being the first to install it on a large scale. Coming to a discussion of the papers, Mr. Sprague said that it was due time that the subject of electricity versus steam be discussed and not this or that system of electric motive power. He thought that enough systems have been electrically operated to obtain good conclusive data on the subject in order to compare it with steam operation. He spoke of the electrification that had been accomplished in the vi-

cinity of New York and said there has been a reluctance on the part of the systems and engineers in charge to give actual operating data. He highly commended Mr. Wood's paper for the data it contains and said that the example set by Mr. Wood in approaching his road and asking for definite cost data to present to the American Institute should be followed by other engineers. He also emphasized some of the data presented in the paper comparing single-phase with direct-current operation.

Referring to Mr. Murray's paper, Mr. Sprague criticised single-phase operation. He said that every train in the electric zone of the New York, New Haven & Hartford Road should be operated by electricity. Mr. Sprague disagreed with Mr. Murray's statements regarding storage batteries and in conclusion urged the centralization of power stations with supply from a limited number of them and again emphasized the importance of making it a battle between steam and electricity.

Edwin B. Katte commended Mr. Wood's paper, but regretted the fact that there was no comparative data between steam and electricity. Speaking of Mr. Murray's paper, Mr. Katte called attention to the figures showing that the cost of maintenance of a single-phase trolley installation was six times as large as the maintenance of the third-rail system. Also that in a unit length of time the detention of trains due to motive power on the direct-current lines was twenty-eight minutes as compared with 1,920 minutes on the single-phase system. Mr. Katte regretted that Mr. Murray did not present more data on comparisons between steam and electricity, but said that this is probably not available because of the mixed operation on the New York, New Haven & Hartford system. He compared operating data relative to direct-current operation on the New York Central lines with the data on single-phase operation presented by Mr. Murray. The figures indicated the better reliability of direct-current operation. Regarding first cost, Mr. Katte said that for the single-phase it was $71,000 per mile as compared with $51,000 for the direct-current.

L. C. Fritch spoke of the subject of electrification from the railroad man's point of view. He said railroad men are making a mistake in warding off electrification, which is inevitable. He compared the weights and tractive efforts of the new Mallet steam locomotives with the modern types of electric locomotives, showing the much lighter weight and greater power of the latter, and thought that the latest development in the steam locomotive is the dying gasp of steam operation. He said that railroad companies have spent millions of dollars in line revision, tunneling, grading, etc., which could have been more profitably spent in electrification. Speaking of the conditions in Chicago, Mr. Fritch said that a universal system of electrification is necessary owing to the use of the various switching facilities by other roads. Mr. Fritch spoke of the chaotic conditions of the tracks and terminals in Chicago, and said that a complete revision of the terminals is necessary. For switching he thought that the overhead-trolley system was, of course, the only feasible one.

Mr. Woodbridge contributed a discussion on storage batteries taking issue with the statements made by Mr. Murray. To show the applicability of storage batteries to railway operation, he referred to the Chicago City Railway Company, and notably the installation at the Plymouth Street substation, which pays twelve per cent on the investment. He said while this is for city operation, the application of storage batteries to trunk lines is still more favorable. He added that the presence of a storage battery on the system is an insurance of reliability which permits of a more economical operation of a plant due to the fact that it is not necessary to hold apparatus in readiness for emergency operation. He described automatic apparatus now available, which permits of using current when desired, taking load fluctuations only when commercially economical.

President D. C. Jackson discussed briefly Mr. Wood's and Mr. Murray's papers and paid a tribute to the engineers of the New York, New Haven & Hartford road in accomplishing what they have in so short a time. Speaking of the statement that there is no standardization in electrification, Mr. Jackson said that this is entirely unfounded, for while there are three acknowledged systems each is standardized. He said that all three have their good features and are necessary to apply to the various conditions met with. In conclusion he said that the fiscal advantages of trunk-line electrification are just as great as on city and suburban lines.

N. W. Storer defended some of the points brought up in Mr. Murray's paper and spoke of the unfairness of comparing the cost data between single-phase and direct-current operation when the conditions which led to the cost of maintenance were not known. He spoke of the value of the single-phase system for terminal and yard operation and commended Mr. Murray for the work he has accomplished in the freight yards of the New York, New Haven & Hartford road. Mr. Storer also recommended the use of coasting time clocks as a measure to reduce the wear on brake shoes.

John W. Lieb, Jr., spoke of electrification from the central-station operator's viewpoint. He said that central station companies of course desire to supply the railroads electrifying with energy and while this apparently is a selfish attitude, it would also tend greatly to hasten electrification by eliminating the great item of the cost of a station, it would insure much more economical and reliable results than could otherwise be accomplished, and in addition would be mutually beneficial. He urged that twenty-five cycle energy be standardized for this service. Speaking of storage batteries, Mr. Lieb said that the records for continuity of service now enjoyed by a large number of central-station companies would have been impossible without their use.

Charles F. Scott recalled the convention of the American Institute at Great Barrington, Mass., in which it was the consensus of opinion that could a reliable single-phase motor be produced the problems of electrification of trunk lines would be materially simplified. Mr. Scott said that this motor is now available. The manufacturers have done their part and it is encumbent on the engineers to devise some method of operation.

In closing the discussion Mr. Wood spoke of Mr. Lieb's statement regarding railroads purchasing power. He said that railroads naturally want to buy power as they do not care to invest large amounts of money where the returns, if any, will be small. He said that the reason for railroads establishing their own plants was the fault of the central station.

Mr. Murray in closing the discussion

on his paper said that he also regrets that it is impossible to furnish comparative data on costs of steam and electric operation, but that owing to the mixed operation of the New York, New Haven & Hartford road this is at present impossible. He said, however, that over 200 miles of single-phase line will be in operation within the next fifteen months and that figures will then be available. Defending single-phase operation, Mr. Murray said that the action of the railroad in pledging $12,000,000 for the extension of this system was an indication of its satisfactory operation. He regretted the attitude taken by Mr. Sprague and said that direct current has been in general use for electric motive power since 1887, but that the history of single-phase operation dates back only five or six years and should be given more time in which to demonstrate its possibilities.

He said further that based upon experience it is clear that the economies involved in single-phase operation will cover the interest on the electrification cost of the New York, New Haven and Hartford road.

Telegraphy and Telephony Session.

The telegraphy and telephony session was assembled at 3 p. m. Wednesday with J. G. Wray, of Chicago, member of the Telegraphy and Telephony Committee, presiding. The first paper on the program was that by George O. Squier on "Multiplex Telephony and Telegraphy by Means of Electric Waves Guided by Wires." Owing to the absence of the author at San Antonio, Tex., the paper was presented in abstract by Samuel G. McMeen, of Chicago.

MULTIPLEX TELEPHONY AND TELEGRAPHY.

Major Squier's paper gives in detail the results of the extended experiments made by him at Washington to determine the feasibility of superposing on an ordinary telephone line one or more separate telephonic circuits actuated by high-frequency currents that would not interfere with each other. His idea was to use frequencies above the limit of audibility, viz., from 15,000 to 100,000 cycles per second. The telephone line used in the experiments had a length of about seven miles. It was a twisted pair carried in lead-covered cable from the Bureau of Standards through three telephone exchanges to the laboratory of the Signal Corps. With the exception of 3,400 feet, all the cable was underground. The line resistance was 776 ohms, and the capacity 0.69 microfarads. A specially constructed 100,000-cycle generator was used as the source of the high frequencies. The first tests showed that frequencies from 30,000 to 100,000 could be impressed on the line without being detected in the ordinary telephone receivers. The line was then equipped with the ordinary telephonic apparatus at each end and a high-frequency equipment of the wireless type was also placed at each end; the latter included a microphone transmitter and a perikon crystal detector. By means of a double-throw switch an interrupter could be substituted for the microphone, thus permitting high-frequency telegraphic signals to be sent and received. Speech was transmitted and received successfully over one of the wires with ground return. At the same time the ordinary low-frequency telephone equipment was successfully used without interference from the high-frequency currents, thus achieving true duplex telephony. By the insertion of tuning inductances and condensers the transmission was improved and cross-talk and earth disturbances eliminated. An audion detector was used in the final experiments and both bridging and series arrangements successfully used. By holding one telephone receiver to one ear and the other receiver to the other ear, the receiving operator could hear two entirely different conversations simultaneously over the same pair of wires. Duplex-diplex Morse and high-frequency telegraphy was also carried on. Many measurements of electric waves at frequencies from 20,000 to 100,000 were also made and numerous resonance curves drawn for the open and closed line. The author concludes his important paper by calling attention to the fact that his system is not intended to supplant, but rather to supplement the present systems. He contends that his experiments show the value of a metallic wire guide for the energy of electric waves, thus furnishing a directive wireless system and solving the problem of interference of messages, at the same time reducing the distortion of speech.

Frank B. Jewett, of New York, opened the discussion of this paper by calling attention to the greatly increased attenuation produced with high-frequency currents. At 15,000 cycles this is 2.2 times, and at 100,000 cycles 5.2 times the attenuation prevailing at 800 cycles, which is the average telephonic frequency now in use. To give commercial service on long lines it is necessary to provide at least as much energy at the receiving end as is now employed. But on a 1,000-mile line this would require that 4,000 times as much energy be impressed at the sending end on a 15,000-cycle circuit as is now used on an 800-cycle circuit; on a 1,000-mile 50,000-cycle circuit the impressed energy would have to be 300,000,000 times, and with 100,000 cycles it would have to be even 7×10^{12} times what is now required with ordinary circuits. To avoid inductive disturbances between different but adjoining high-frequency lines would require more frequent transpositions than there are poles on the lines. Every relay and induction coil in series would act as a barrier to the high-frequency currents and would therefore have to be shunted by means of a condenser. Calculation shows that the insertion of these condensers would impair the value of the loading coils and make them extremely expensive. In conclusion, Dr. Jewett regarded Major Squier's tests as beautiful laboratory experiments, but scarcely applicable to commercial long-distance telephone service.

Ernst F. W. Alexanderson, of Schenectady, N. Y., who had designed the 100,000-cycle generator used by Major Squier, admitted that these extremely high frequencies introduced practical difficulties into the application of the Squier method to commercial lines. He spoke of tests in which 10,000-cycle currents were used and stated that he is constructing a generator to give 3,000 cycles on tuned circuits.

J. B. Taylor, of Schenectady, mentioned various methods of producing multiplex telegraphy by the synchronous and harmonic systems and the difficulties encountered in making them practically serviceable.

S. G. McMeen closed the discussion on behalf of Major Squier. He said that signaling is not a troublesome feature of the high-frequency line, as had been shown in the Major's tests. It is true that series coils are an impediment, but they are almost entirely avoided in the Squier system. The bridging of the inductances by condensers is not so serious a problem as it seems, because the condensers required would be small and the capacity might be supplied by the equipment itself. Mr. McMeen emphasized the fact that the investigation of harmonic telegraphy had led Professor Bell to the invention of the telephone itself. Major Squier's experiments may be regarded as laboratory experiments, but so were those of Bell that resulted in the telephone. At any rate the work of Squier is a strikingly new development in telephony and there have been no radical developments in this field for many years.

The next paper was one by Frank F. Fowle, of Chicago, on "Telegraph Transmission." An abstract prepared by the author was read by Franklin H. Reed.

TELEGRAPH TRANSMISSION.

Mr. Fowle's paper is a development of the theory of closed-circuit Morse transmission. The well known *KR* law has been applied to open-wire lines, as well as cables,

but for the former it fails to hold because of considerable leakage and some inductance which they possess. The author considers the problem from the single standpoint of strength of signals, which is the most important element and simplifies the solution. Simplex, duplex and quadruplex systems are studied with special reference to terminal conditions and to the distance that definite signals can be sent. The calculation of limiting line lengths, with wires of given resistances, depends critically upon the minimum value of insulation resistance. This value occurs during heavy or prolonged rainfall or during very heavy mist or fog. The author discusses line insulation and types of insulators, expressing surprise that the superior qualities of porcelain to glass have not been generally recognized in telegraph-line building. He then takes up a consideration of transmission requirements of various systems as influenced by the type of relays used. After some comments on relay design there follow some suggestions for general improvements in terminal conditions and in line insulation. Mr. Fowle concludes his paper with the presentation of some new designs of insulators for telegraph lines. Particularly interesting are the underhung and suspension types that he recommends.

Bancroft Gherardi, of New York, briefly discussed the paper. He said Mr. Fowle's recommendation of improvement in line insulation had been particularly interesting to him, though he doubted the general applicability of the suspension-type insulator.

A paper on "Commercial Loading of Telephone Circuits in the Bell System" was then presented in abstract by its author, B. Gherardi.

LOADING OF TELEPHONE CIRCUITS.

Mr. Gherardi's paper opens with a discussion of the need for and the theory of loading telephone circuits. Prof. M. I. Pupin in 1900 developed a general practical method of reducing the attenuation of long lines by the insertion at definite intervals of concentrated inductance or "loading" coils. By adding six coils per wave-length the effect is within four per cent of that of uniformly distributed inductance. The problem of loading underground cables is easier than that of loading open-wire lines. For cables two types of loading are generally employed; heavy loading provides about 0.2 henry per mile with coils 1.25 miles apart; medium loading provides 0.1 henry per mile and coils 1.75 miles apart; light loading is also occasionally used. For each type, however, the coils are of the same general design. The core is ring-shaped or toroidal, it is made up of very fine iron wires, some cores having nearly thirty miles of iron wire. Two copper windings are placed around and through the ring, one on each half thereof for each side of the line. The design is such as to reduce the losses to a minimum. The coils are assembled in groups of seven on seven spindles, thus putting forty-nine into a case. The cases are all assembled complete and sealed with a stub cable that needs merely to be spliced into the line cable. The author describes the loading of the New York-Philadelphia underground cable and of the cables between Philadelphia and Washington and between New York and Boston. Special arrangements of the loading coils are necessary in order to allow of phantom working. For loading open-wire lines the coils are larger and heavier, both on account of increased length of lines and to guard against lightning disturbances. Loaded cables have also been used to bring loaded open-wire lines into cities. There are in use in the United States over 85,000 miles of loaded open-wire circuits and 170,000 miles of loaded underground cable circuits, a total of 125,000 loading coils being required.

E. H. Bangs, of Chicago, emphasized the intricacy of the loading problem by showing that the working out of its details has taken nearly ten years.

Dr. Jewett stated that the actual attenuation effect can be exactly predetermined when the constants in the formulas are known, so that the latter can be rigorously applied. The introduction of loading requires a very much higher grade of line maintenance. An important practical feature in the case of parallel cables is that these must be of the same capacity so that the loading coils may be placed in the same manholes.

Mr. Coller said that loading has required considerable refinement in instruments and methods for the measurement of the constants of circuits, the measurement of iron losses at low excitations, losses in dielectrics, effective resistance of loading coils, etc.

E. B. Craft, of New York, described some interesting details of the construction of loading coils, particularly those used in the New York-Washington underground cables. Enamel insulation is much used. Automatic machinery was developed for winding the ring-shaped core. A case containing twenty-one coils weighs about 3,000 pounds.

George D. Shepardson asked what influence the change from underground cable to overhead line makes in the loading of a circuit.

Allard Smith described the use of some 20,000 loading coils in Chicago in the lines radiating from the central toll exchange.

J. G. Wray stated that without the use of loading coils it would be impossible in Chicago to have satisfactory telephonic transmission across the city.

Mr. Gherardi closed the discussion by replying to Professor Shepardson's query. The same basis of loading is used in underground as in overhead cables, so when a change from one to another is made the same electrical loading applies.

F. P. Valentine, of Boston, then presented in abstract his paper on "Problems in Telephone Traffic Engineering."

TELEPHONE TRAFFIC ENGINEERING.

In this paper Mr. Valentine contends that there are many traffic problems in whose solution it is not necessary to depend solely upon opinion or judgment, but that by analytical study many apparently intangible factors may be reduced to known values, whose relationships can be definitely established and their laws derived for general application. The traffic department of a telephone company is directly responsible to the subscriber for the quality of the service and to the stockholders for the economy of that service. Five factors enter into the production of telephone service: quality of service, efficiency of labor, efficiency of operating methods, production efficiency of central-office equipment, and production efficiency of trunk and toll circuits. By careful training of operators, systematic method of service inspection, tracing of service criticisms, adoption of standard methods of operating and standards of speed and accuracy, the entire operating procedure has been reduced to standard practice and the quality of service maintained at its highest. Careful consideration led to the adoption of the flat-rate non-trunked call on a No. 1 relay board as a unit call. The average skilled operator can handle 230 such calls per hour throughout her working day and about twenty-five per cent above this during the peak traffic hour. The training of operators is a serious problem, but has been systematized in operators' schools so that the above standard of proficiency is steadily maintained. By careful selection, training and caring for the employees the average length of employment of operators has been increased twenty per cent. Great improvements in operating methods have resulted from specializing the handling of irregular calls. Development studies for future growth are now systematically made and the necessary central-office equipment quite accurately predetermined by the traffic engineer. The author goes into considerable detail regarding the various methods of handling trunk and toll circuits. These are of two classes, suburban lines affording "short-haul" traffic and long-distance lines for "long-haul" traffic, and require different methods. The former, particularly, has been vastly improved both in speed and simplicity by careful study of its characteristics and requirements.

A. P. Allen, of Chicago, in discussing this paper, said that it leads to the conclusion that accurate traffic predictions are now possible. He thought, however, that such problems are very difficult of accurate solution because of the great fluctuations of service. He did not think that we have yet reached the point where all of Mr. Valentine's ideas can be applied, although future indications are hopeful.

W. Lee Campbell thought that, if operators could be kept more uniformly busy, traffic would be more systematically handled. He suggested the adoption of some automatic load-distributing device, which would even up the traffic among most of the operating force and require only a relatively small number of reserve operators to handle the abnormal fluctuations in calls. This should result in improved efficiency of the operators and a reduction in their number.

Mr. Valentine closed the discussion by showing that many of the former elusive problems have now been worked out by traffic engineers. The session adjourned at 5:30 p. m.

High Tension Transmission Sessions.

Two sessions were held for the discussion of high-tension transmission, the first taking place on Thursday morning and the second consisting of a parallel meeting on Friday morning. After calling the Thursday session to order, President Jackson asked Percy H. Thomas, chairman of the High-Tension Transmission Committee, to preside.

The first paper to be presented was one by G. Faccioli, entitled "Electric Line Oscillations." In the absence of the author this was presented in abstract by C. P. Steinmetz.

ELECTRIC LINE OSCILLATIONS.

Tests performed in 1910 under no-load conditions on the 100,000-volt line of the Great Western Power Company are described, the oscillograph being extensively used to record the oscillations produced by switching the line, the transformers, or both, on and off. The inductance of each line conductor is 0.323 henry, the capacity to the neutral is 2.2 microfarads, and the resistance is 50 ohms. The 10,000-kilowatt generator is star-connected and the neutral not grounded. It gives 11,000 volts. The synchronous reactance is 0.016 henry. Referred to the high-tension side is 1.52 henries. The leakage inductance of the generator and of the transformer, referred to the high-tension side, are 0.253 and 0.088 henry, respectively. Detailed records are given of the different experiments, the oscillograms showing the current and voltage waves, and indicating in many cases high-frequency oscillations. Oscillograms were taken both at the station where the switching was done, at the other end of the 154-mile line, and at an intermediate point on the line. Switching was done on both the high-tension and the low-tension circuits. The maximum voltage recorded is 160 per cent of normal. Protection is shown to be necessary against high-frequency impulses, and lightning arresters in series with spark gaps do not always answer the purpse effectively. Danger consists in the possibility that these frequencies will coincide with that of the generating system or its harmonics, but this can be determined by calculation. There is danger also from the local piling up, as in the end terms of a transformer.

The high-frequency impulses, which originate at the point where the switching is performed, extend over a short length of the circuit only. The steepness of such impulses is quickly reduced and smoothed over and their effect is localized. Low-tension switching is preferable to high-tension switching. In this connection, it is interesting to note that high-tension switching may be undesirable when transformers are near the switching point, in which case low-tension switching may be generally arranged for. In energizing a line two methods of procedure may be followed: (*a*) the open line is connected to the generating system, and the step-down transformer is thrown on the end of the live line; (*b*) the step-down transformer is connected to the dead line and then line and transformer are connected to the generating system. The records show that the second method is the best, as it produces one oscillation only and this oscillation is of the same character as the less severe of the two oscillations which take place in the first procedure.

The discussion was opened by M. H. Collbohm, who had made some similar observations upon a 66,000-volt line and had observed a seventeenth harmonic having an amplitude of about five per cent. The fact that these higher harmonics are developed upon the line makes it immaterial whether they exist in the generator voltage or not. He did not consider that much protection is afforded by lightning arresters of the prevalent type, but had found that dry condensers shunted by choke coils were very successful. He also mentioned the use of a short section of iron wire of high permeability at the end of the line. The skin effect causes this to have a high resistance for high-frequency oscillations.

D. B. Rushmore spoke at some length of the importance of the work which had been done by Mr. Faccioli.

C. P. Steinmetz, referring to one of the high voltages which had been measured across the terminals of a choke coil, pointed out that the value of the frequency which had been computed as necessary to produce this result was about 2,000,000 cycles.

Two papers dealing with the measurement of electric strength of air and corona were presented at this session and discussed together. The first was by John B. Whitehead entitled "Electric Strength of Air." The second was by F. W. Peek, Jr., entitled "The Law of Corona and the Dielectric Strength of Air."

ELECTRIC STRENGTH OF AIR.

This work is a continuation of that reported at the last annual convention, in measurements of the voltage at which corona takes place between a wire and a surrounding metal cylinder. The critical surface intensity or voltage gradient at which this occurs is given by the formula, $E=32+13.4/\sqrt{d}$ where E is the potential gradient in kilovolts per centimeter and d is the diameter of the conductor in centimeters. Visible corona appears at the same time that the neighboring air becomes conducting and discharges an electroscope which is used as a test instrument. The apparatus can be sealed and air under different conditions of pressure, moisture, etc., admitted. Intense ionization of the air, as produced by Röntgen rays, and atmospheric humidity are found to have no effect upon the results. The discharge potential gradient is found to have a linear relation with the pressure, but this varies slightly with the size of the wire. With increasing frequency the corona starts at lower values of voltage. Between twenty-five and sixty cycles its lowering is about two per cent; at ninety cycles about six per cent. It was found necessary to corrcet the observed values for wave form. If the surface of the wire is rough or dirty the necessary value of the voltage is lower. Stranding the conductor also lowers the critical voltage, the lowering being greater tne fewer the number of strands. The overall diameter of the stranded conductor bears a ratio to the diameter of a single wire giving the same critical voltage, which is 0.7 for three strands and 0.88 for nine strands. Intermediate values are also given. A discussion of the results on the basis of the ionization theory is given.

CORONA AND STRENGTH OF AIR.

This paper describes and summarizes the results obtained in experiments carried on for some years upon an experimental line by the General Electric Company. The test apparatus was mounted in freight cars running on a track directly beneath the line. The conductors were mounted upon metal towers in parallel lines of two spans each, the length of span being 150 meters. They were supported by seven disk suspension insulators. Various sizes of conductors, including stranded cable, were used. The motor-generator set was mounted in the car so as to give direct control of frequency and voltage. A step-up transformer rated at 200,000 volts, 100 kilowatts and sixty cycles had the high-tension winding open at the middle point and taps brought out for the insertion of ammeter and wattmeter. This point was grounded. There were four low-voltage coils, each wound for 500 volts, which could be connected in series or parallel. An extra tap of the high-tension winding was also brought out for voltage measurements. Voltage and power measurements were made both on the high-tension and low-tension sides. Special conductors were mounted in a separate car for observations of the visible corona. The power was found to be proportional to the frequency at any given voltage between the experimental limits of forty-five and 100 cycles. The power loss was found to be proportional to the square of the excess of line voltage above the critical disruptive voltage, the voltage being measured to the neutral. This disruptive critical voltage is lower than the critical visual voltage. The above relation is departed from for voltages near the critical. For conductors of large diameter the loss is greater than that given by the quadratic formula, while with small wires the loss is less. This is explained by two considerations. The irregularities of the surface cause a loss at a value below the disruptive critical voltage for a smooth surface, this effect being more apparent for wires of large size. The loss of power does not begin at the critical voltage at which the disruptive gradient is reached at the conductor surface, but only after the disruptive strength of air has been reached for an appreciable distance from the conductor. This is attributed to the necessity for an accumulation of energy to cause actual discharge. The disruptive gradient is found to be 29.8 kilovolts per centimeter. The corresponding breakdown voltage, however, is proportional also to the radius of the conductor, to the logarithm of the quotient of the distance between conductors divided by the radius, and also to a factor which depends upon the condition of the surface and upon the number of strands. It is also proportional to the density of the air as affected by temperature and pressure. Humidity and wind have no effect upon the loss nor the critical voltage, but fog, sleet, rain and especially snow lower the critical voltage and increase the loss.

The discussion was opened by C. P. Steinmetz who pointed out the great value of these two papers, which solved the problem of corona. It is now posble to predetermine the conditions upon high-voltage lines by calculation. He stated his disbelief in the ionization theory, but proceeded to explain some of the phenomena by its use. He pointed out that for transient voltages

the breadown strength for air as well as for other insulators was higher than for steady alternating voltages and that the corona effect was not observed in such cases.

C. M. Davis discussed the explanation of some of the phenomena concerned, and sought to explain them through the means of some experiments carried out with two wires strung so close together that the disruptive discharge prevented the formation of corona. By spacing the two wires at the critical distance where the conditions changed from those favoring disruptive discharge to those favoring corona, it was possible to obtain both of the critical distance where the condition which he described as a puff discharge. By plotting a curve between voltage and distance and projecting this back to the axis he found a value of 30,000 volts per centimeter as the breakdown strength for wires of zero diameter and zero separation.

A. B. Hendricks, Jr., referred to the voltmeter suggested by Professor Ryan, based on the corona, and pointed out that the papers of the day indicated that accurate results could be obtained with it. He considered it superior to the spark gap in the measurement of high voltage. The critical ratio of distance to diameter of conductor, computed on theoretical grounds is not borne out by experiment. He stated that the electric strength of oil as well as that of air was increased by pressure, 200 pounds per square inch being sufficient to double its value.

C. F. Scott surveyed the progress in high-tension transmission and pointed out the new order of things which was due to investigations such as those which had been described in the papers.

J. B. Whitehead advocated the use of the term "electric strength" rather than "dielectric strength" and discussed the explanation of the phenomena involved. He stated that there was no loss in air except in the presence of corona or other forms of discharge and thought that the apparent existence of such a loss was due to overlooking a brush or small spark discharge. The discussion was then closed by Mr. Peek.

The remainder of the session was devoted to a discussion of transmission problems, the discussion being opened by a number of printed papers by representatives of some of the operating companies. These were contributed by J. P. Jollyman of the Great Western Power Company; W. S. Lee of the Southern Power Company; Max Hibgen of the Great Falls Power Company, and J. T. Hanscom of the Central Colorado Power Company.

GREAT WESTERN POWER COMPANY.

Length of line, 154 miles. Operation at 100,000 volts, sixty cycles. Transformers are connected in delta on high-tension side. No connection to ground except through electrolytic lightning arresters. One ground wire is supported on the apex of the tower and is grounded at each tower. The standard span is 750 feet, the longest span 2,740 feet. Two circuits of 3-0, seven-strand copper cable are used, each circuit lying in a vertical plane and being completely transposed every ten miles. There has been no trouble from lightning. The distance between conductors is 13.3 feet. Strain-type insulators are used and very few have broken. There has been no trouble with swinging of conductors nor with oil switches. The power-factor is near unity, the connected load being of all kinds. Four 10,000-kilowatt generators are installed at Big Bend, Cal., each connected to a three-phase transformer of the same capacity. There is no appreciable corona. The telephone line is strung on the towers from a grounded messenger cable. Reactance coils with the center point grounded are used at each end of the line and at the center, reducing the potential of the telephone line to less than 100 volts above ground. The line is transposed at every tower. Service is very satisfactory.

SOUTHERN POWER COMPANY.

Two lines of 161 and 96 miles; 100,000 volts, sixty cycles. Voltage is stepped up from 44,000 with transformers connected delta on low-tension side and star on high-tension side, with neutral grounded. Overhead ground wires are used; one from peak to peak of the steel towers and one on each side, grounded at each tower. Conductors are 2-0 seven-strand copper and aluminum cables. Standard span is 600 feet; longest span 600 feet. There are frequent lightning storms which have produced a number of shutdowns. The only trouble with insulators has been due to hooks pulling out. There has been no trouble from switching. Electrolytic lightning arresters have been used with satisfaction. There is no telephone disturbance and no corona effects.

GREAT FALLS POWER COMPANY.

Length of line 282 miles; 100,000 volts, 60 cycles. Two circuits are run on separate tower lines with telephone between. Two ground wires are clamped to the steel towers. Transformers are delta-connected. The standard span is 600 feet and the longest span is 3,034 feet. The three conductors lie in a horizontal plane with no transpositions. They are No. 0 B. & S. gauge, copper cable. Lightning storms are frequent, but have caused no shutdowns. Suspension-type insulators are used and there have been no failures. The line is controlled by solenoid-operated oil switches, which are satisfactory. The power-factor is ninety-nine per cent. Electrolytic lightning arresters are used at both ends of the line and in the middle. These usually discharge during lightning storms and when high-tension switching is done. Corona was plainly visible when the line was started, but gradually disappeared. This is believed to be due to roughness on the surface of the wires which has gradually burned off. The telephone line gave trouble until reactance coils were bridged across it with their middle points grounded at each end and at the middle of the line.

CENTRAL COLORADO POWER COMPANY.

The transformers at the Glenwood power house and at substations are delta-connected. At the Boulder power house they are star-connected with ungrounded neutral. Two ground wires are used. The standard span is 660 feet, the longest span 2,900 feet. There were ten interruptions from lightning during 1910. The records of the operating department are given. There has been no trouble with insulators. Where exposed to violent winds there has been difficulty due to lack of stability of the conductors. The spacing of conductors has had to be increased at some points. Oil-break switches are installed at substations, but not at the power stations. No difficulties have been experienced when switching either with or without load. The power-factor is close to unity. Aluminum-cell lightning arresters have been used with satisfaction. The telephone line is operated without disturbance.

These papers were not read in full, but discussion was opened by Chairman Thomas, who mentioned some of the principal considerations which had been brought up and which represented the problems with which the transmission engineer had to deal. His difficulties were not due to high voltage such as used today, but higher voltages would involve considerable losses through corona effects. He devoted considerable time to the discussion of the wave motion which might take place with lines on suspension insulators and the elements affecting this, such as length of span, length of suspension, material of conductor, (copper, aluminum, steel ground-wire) the repulsion between different conductors on short-circuit, wind pressure, adjacent long and short spans, etc.

M. H. Collbohm spoke of the danger arising from the use of ungrounded delta systems and stated that an aluminum-cell lightning arrester had been blown up three or four times on such a system with which he had been connected, due merely to switching.

P. M. Lincoln considered grounding the neutral through a resistance very desirable, the advantages more than counter-balancing the disadvantages. Some lines are grounded without a resistance and on some the ground is even used as a return circuit.

L. C. Nicholson agreed that it was desirable to ground through a resistance, a value of 1,000 ohms being suitable for a 60,000-volt circuit. This would limit the current to about forty amperes on short-circuit and such a value does not greatly disturb the line. An arcing ground is not maintained and he considered such a ground very dangerous especially when the arc consisted of a capacity current rather than a power current. A current of this

value may pass without throwing out switches which are operated by ten-second relays. On the other hand, without a resistance arcing grounds may carry as much as 2,000 amperes, which is a dangerous value. Grounding moreover permits the sectionalization of the line since the current through the neutral shows the location of the ground.

N. J. Neall stated that an ungrounded system requires higher insulation in order to maintain continuity of service. He thought it would be very desirable to have the practice of the different companies in tying in the branch lines and as to whether these were connected through oil switches. He quoted from the report of the committee of the National Electric Light Association which stated that electrolytic lightning arresters were satisfactory, but required careful attention. The lightning arrester was formerly regarded in the same light as a fuse and its destruction in saving the other apparatus was considered proper, but the demand nowadays is for an arrester that will not only protect the apparatus but remain intact itself. Mr. Neall also abstracted the written discussion submitted by J. F. Vaughan. The latter stated that since ground wires had been erected over the transmission line no trouble had been experienced.

The session then adjourned.

The second high-tension transmission session was called to order shortly after 10 a. m. on Friday with David B. Rushmore in the chair. The first paper taken up was by W. L. R. Robertson entitled "Solution of Problems in Sags and Spans." This was followed by the paper by Percy H. Thomas entitled "Sag Calculations for Suspended Wires," and the paper by Harold Pender and H. F. Thomson entitled "Mechanical and Electrical Characteristics of Transmission Lines."

SOLUTION OF PROBLEMS IN SAGS AND SPANS.

The paper read by Mr. Robertson took up the process of development of the solution of sag and span problems making mention of the fact that heretofore the solutions were approximate and applied to cases where the sag was very small as compared to the span. Several assumptions formerly made were not exactly correct, and the results were only applicable to one material, necessitating a complete recalculation of another kind of wire. In this paper the important question of large sag was especially considered. A number of tables for the selection of the approximate catenary were included. The effect of changes in temperature and stress was taken up and a hypothetical problem was solved. Mr. Robertson defined sag as a difference in height between the lowest point of the curve and the point of support; and in dealing with supports at different levels, reckoned the sag from the higher support. An interesting feature mentioned in connection with spans on supports at different levels is that when the vertex of the curve lies outside of the two supports, there is a small vertical force exerted on the lower support, tending to lift the support.

SAG CALCULATIONS FOR SUSPENDED WIRES.

The method of calculations taken up by Mr. Thomas gives special consideration to the semi-graphical method of calculating sags and strains in suspended wire. The scheme is simple and involves only simple slide-rule calculations. The method is based on the assumption that the conductor conformed to a catenary curve which is only slightly in error of spans of short or moderate length. A short span was taken as an example and in connection with curves, the effect of temperature, accumulation of sleet and ice and other disturbing causes were calculated.

MECHANICAL AND ELECTRICAL CHARACTERISTICS.

The paper prepared by Harold Pender and H. F. Thompson presented in a compact form the data and formulae with the method of deriving them, which are required in the determination of both the mechanical and electric characteristics of transmission lines. A set of charts was used with which the various mathematical operations could be rapidly done. The mechanical characteristics and electric characteristics were taken up separately. In dealing with the first mentioned, the discussion was limited to the characteristics of a perfectly flexible wire suspended from two fixed points. Two problems were taken up, the first being concerned with the tension at which a wire must be strung in order that the tension under bad conditions of ice and wind would not exceed a definite limit, and second, maximum vertical sag of wire when given variation in loading and temperature is assumed. Taking up electric characteristics, the losses were divided into the following factors: (1), the amount of power delivered; (2), the voltage at which the power is delivered; (3), the power factor at the receiving end; (4), the frequency of the system; (5), the kind of line—three-phase or single-phase; (6), the length of the line; (7), the size of the wires; (8), the material of the wires; (9), the temperature of the wires; (10), the arrangement of the wires on the poles; particularly their distance apart. Each of these, together with its inter-relation to the other items was separately considered, charts and mathematical formulae being used.

Paul M. Lincoln opened the discussion, commending the papers which were presented, and in referring particularly to the paper by Messrs. Pender and Thomson said that it is evident that the old methods of calculating the characteristics of sixty-cycle transmission lines up to 100 miles in length are preferable. Speaking of the solution of problems in sags Mr. Lincoln said that the parabola method seems to be the most satisfactory. Discussing Mr. Thomas's paper further, Mr. Lincoln said that the author did not assume that there would be stretching in the supports, and that this must be taken into consideration particularly where there are angles in the lines.

L. C. Nicholson added that there are questions which should determine the sag and spacing of conductors other than mechanical considerations such as the weight and size of wire. He said that it is usual practice simply to specify the length of line and voltage and not take into consideration the other features. In regard to suspension insulators, Mr. Nicholson asked what strain a line would have to stand when one, two or three insulators are broken; or in other words what factor of safety has to be provided in order to take care of this condition. N. J. Neall spoke of the value of a full mathematical treatment of the subjects as brought out in the papers presented.

J. B. Balcomb stated that the maximum stress produced by oscillation due to wind is a point that has been neglected in line calculations. He also spoke of the advisability of having a paper presented containing data on various transmission lines throughout the country to test out the formulae presented in the papers.

W. E. Belcher continued the discussion, explaining the method of calculating the transmission lines recently installed in the vicinity of Colorado Springs. He explained that in using suspension-type insulators where the spans of wires are of unequal length, the horizontal component is greater in the longer spans than in the shorter spans. This accounts for insulators leaning back on transmission lines down hills.

At this point a communication was read from the Indiana Steel Company explaining the reason for not taking the delegation which visited the plant on Thursday through the rolling mills. It was stated that owing to a larger party visiting the works than was anticipated the danger of going through the plant was too great to allow an inspection. An invitation, however, was also extended to any parties who wished to make the trip hereafter.

The paper by A. O. Austin entitled "The High-Efficiency Suspension Insulator" was then taken up.

THE HIGH-EFFICIENCY SUSPENSION INSULATOR.

Mr. Austin's paper discusses rather fully the considerations which led to the design of the high-efficiency type of suspension insulator. Shortly before 1904 considerable improvement had been made in design to obtain higher flashover of the insulator under storm conditions by giving the insulator large striking distances between surfaces. This, however, was carried to extreme in some designs, according to the

author. The amount of depreciation which an insulator will stand and not lower its rating depends upon the excess in surface insulation between the points where the arc forms. In the pin-type insulator it is very difficult to obtain the same ratio between surface resistance and the flashing distance, as a slight change in the distance or conditions varies the relative values to a large extent. In the suspension insulator, however, Mr. Austin believes there are more nearly ideal conditions. Analyzing the requisites of a high-efficiency insulator, Mr. Austin points out that in service the insulator must be regarded as a high resistance. The resistance of an insulator must be determined by taking the width into account as well as the length of leakage path. Surface resistance will vary directly as to length and inversely as to width. He points out that the petticoat is a very efficient way in which to increase surface insulation, for sixteen per cent of material added in the form of petticoats increases the resistance of the lower surface 100 per cent. In addition the petticoat reduces the electrostatic capacity of the flange. This reduces the charging current and gives the section a forty-per-cent higher flashing potential without increasing the distance between cap and pin. Regarding the inclination or spacing of flanges, Mr. Austin states that the smaller the diameter, the greater the permissible inclination for maximum length efficiency. Where insulators of large diameter are used, the length efficiency will be lowered greatly with the inclination of the skirt or flange. The ability of the insulator to carry electrical stress was discussed, the author pointing out that in service, the insulator must withstand two classes of stress; that of the line at normal frequency and voltage, and that of the high-frequency surge. In order to draw conclusions as to reliability in the insulator against puncture, time-puncture curves should be made. These can be obtained by noting the time that each puncture occurs after the potential has been applied and plotting the per cent of breakage in respect to time. Results of tests carried on with different types of insulators are given and in conclusion Mr. Austin presents the following pertinent suggestions: Reliability in practice depends on testing all insulators and connections, eliminating any weak members. Connections must be simple and positive, otherwise where installed on the line, poor workmanship may lower the mechanical reliability. High mechanical strength is obtained in the high-efficiency type by making the gripping surfaces effective and developing the full shearing strength of the cement, permitting of very small metal parts. The electrical advantages of efficiency in design of the high-efficiency suspension insulator are greater dielectric strength, high surface insulation, and lower depreciation. The economical advantages are lower cost of production, lower weights, resulting in a saving in transportation and erection, greater length efficiency permitting of a saving in the height of towers and length of cross arm.

E. E. F. Creighton stated that the methods of testing insulators generally consisted of flooding the insulator by brush discharges. In the laboratory, however, current was taken from the Leyden jar at a frequency of 1,000,000 cycles per second and it was often true that insulators passing through the former tests successfully were punctured instantly when subjected to the laboratory test. He said that the general method of testing insulators does not give any indication of what they will do in actual service. He added that it was possible to design suspension insulators in which the multigap feature entirely disappears.

Paul M. Lincoln spoke briefly of the leakage in insulators and said that a higher flashover point is sometimes obtained when insulators are wet than when dry.

Percy H. Thomas described some trouble which was encountered with high-tension lines in Colorado using multi-gap lightning arresters. This was in the year 1900 and in 1902 Mr. Thomas said that he had to do with the construction of a similar line in which the multi-gap arresters were arranged in a V-form and gave no trouble. He pointed out that it is indicated that high-tension lines should be kept as far apart as possible.

E. M. Hewlett spoke briefly of some reasons for failure of insulators. He said that fatigue often alluded to in insulators was really low burning, and an imperfect vitrification.

Mr. Austin in closing the discussion pointed out that punctures are largely due to mechanical defects.

General Session.

The general session assembled at 10 o'clock Friday morning. George F. Sever, chairman of the Meetings and Papers Committee, presided at this session.

The first paper presented was by Ragnar Wikander, of Pittsburg, on the subject "Economical Design of Direct-Current Electromagnets."

DESIGN OF ELECTROMAGNETS.

The design of an electromagnet for a given duty can as a rule be varied considerably, and while it is comparatively easy to design a magnet that will serve a certain purpose, it requires careful consideration to find the most economical design in any given case. In some cases the most economical design of a magnet will be the one for which the annual cost of the energy which it consumes, added to the depreciation and the interest on the price, will be a minimum. In other cases it is of importance that the magnet should be of compact design and of light weight in order to be transported conveniently, or it may form part of some apparatus and should occupy a minimum of space. In Mr. Wikander's paper the investigations are limited to the design of the cheapest, the most compact or the lightest direct-current magnet which can perform a given comparatively heavy duty. Both continuously and intermittently excited magnets are considered. The former must carry their current steadily without heating. For average conditions of the former type, the most economical flux density is about 90,000 lines per square inch for steel or wrought iron. The paper gives many valuable data and calls attention to several considerations that must be taken into account to prevent a freakish design.

This paper was not discussed.

C. E. Magnusson, of Seattle, Wash., then abstracted the paper on "Electrolytic Corrosion in Reinforced Concrete," of which he and G. H. Smith were joint authors.

ELECTROLYTIC CORROSION IN CONCRETE.

In this paper Professor Magnusson and Mr. Smith discuss the ways in which corrosion of reinforced concrete is probably brought about by electrolysis and how it may be stopped. The question whether such corrosion can be brought about has been quite defintely settled by several investigators, who have shown that an electric current passing from the iron through the concrete will cause corrosion where it leaves the iron and, if continued for a long time, will cause a crack in the concrete. Five explanations have been given: (1) temperature rise due to I^2R losses; (2) hydrostatic pressure at the anode due to current and change of solution density; (3) pressure from generated gases; (4) electrochemical change in the cement, destroying its cohesive strength; (5) change of iron during corrosion to an oxide or salt, whose increased volume may, if continued, cause a sufficiently great stress to rupture the concrete. The first three causes are not likely to produce any appreciable effects with the slight leakage currents met in practice. Numerous experiments were made to ascertain the probability of the fourth cause being an important one; the results, although not ultimately conclusive, indicated that it was not the prime cause. The authors conclude that the fifth cause is the most important one in producing cracks in the concrete. Five methods present themselves for protecting the iron from electrolytic action: First by keeping the iron negative to the surrounding concrete, so it will be the cathode in all cases; this cannot be done with certainty in commercial structures. By using alternating current no electrolytic corrosion takes place and no damage unless very heavy currents cause heating effects. Filling the pores of the concrete with some nonconducting material, so as to prevent the current flowing, can be done in the laboratory, but not effectively in general practice; various waterproofing compounds may serve their purpose, but do not render the concrete a perfect insulator. By coating the iron with some metal like aluminum it is likely to be protected from corrosion, as the film formed on the aluminum acts as an insulator; an inexpensive and practical method of coating the iron with aluminum is necessary, however. Coating the iron bars with insulating compound or paint is effective for a time, but is probably not permanent: moreover, the layer of paint greatly reduces the shearing force between the iron and concrete.

B. McCollum, of Washington, D. C., stated that in some investigations on this subject made at the Bureau of Standards it was found that the region near the cathode in some concrete blocks was softened after being subjected to current at fifteen volts for about seven months. Hitherto it has

been generally believed that corrosion is confined to the anode. He thought that aluminum protection for the iron is deserving of serious consideration. Other coatings are not reliable, however; some thirty waterproofing compounds have been tested and found ineffective as electrolysis preventers. It was also found that the chief corrosion seemed to be due to presence of calcium sulphate in the cement; if this is left out of the cement the corrosibility is greatly reduced. Another theory of the cause of cracking in the concrete was that it is due to the migration of the SO_4 ions to the anode, thus causing disintegration of the cement. All the investigations of the subject so far undertaken have been on a laboratory basis. It has not been conclusively proven that electrolytic corrosion of concrete is in practice an actual menace.

E. W. Stevenson, of Wilkes-Barre, Pa., referred to a case cited in the *Engineering News* of June 8, in which the destruction was definitely asserted to be due to electrolytic corrosion. There was some dispute as to the source of the current, however.

G. A. Hoadley, of Swathmore, Pa., suggested bonding of the reinforcing so as to get a metallic by-pass for the destructive currents.

A. S. Langsdorf, of St. Louis, Mo., said he does not believe that actual operating conditions give cause for alarm from electrolytic corrosion of reinforced concrete.

George D. Shepardson, of Minneapolis, expressed the opinion that most of the disintegration that had been noticed was due to chemical or other purely local causes.

Professor Magnusson briefly closed the discussion. Notice was given that written communications on the subject had been presented by Messrs. Barker and Upson, Guy F. Shafer, and Maximilian Toch.

"Wave Shape of Currents in an Individual Rotor Conductor of a Single-phase Induction Motor" was the title of the next paper, which was presented in abstract by its author, H. Weichsel, of St. Louis.

WAVE SHAPE OF ROTOR CURRENTS.

Mr. Weichsel's paper is an analytical study of the wave shape of the currents in an individual rotor conductor of a single-phase induction motor. Two methods are used in the investigation, that of G. Ferraris, which resolves a single-phase field into two fields rotating in opposite directions, and that used by V. A. Fynn, which considers alternating-current motor problems in a manner akin to those of the direct-current motor. The results by both methods agree. Numerous curves are given for rotor magnetizing and working currents. The standard oscillograph cannot show a stationary picture of these curves, but by the photographic method they can be reproduced in their exact shape. The wave shape consists of three current components. One is the rotor magnetizing current whose frequency equals that of line plus speed frequency. The remaining two are the two components of the rotor working current; one has line plus speed frequency and the other has slip frequency. Therefore two of the three current components have the same frequency, so that the total resultant rotor current is made up of two distinct waves, one with line plus speed frequency and the other with slip frequency.

Theodore Hoock, in discussing this paper, thought that the derived equations should be modified by consideration of the magnitude of the exciting current.

A communication from A. S. McAllister was presented in which he took exception to Mr. Weichsel crediting Fynn with the development of the method of treating alternating-current problems on a basis similar to those of the direct-current motor.

In concluding the discussion Mr. Weichsel admitted he was in error on this point and said he would revise his paper to show that Dr. McAllister deserved the credit assigned to Fynn.

At this point Professor Magnusson submitted resolutions of thanks to the local convention committee and to the hosts of the Institute to whom the great success of the Chicago convention was so markedly due.

The next paper upon the program was on "The Choice of Rotor Diameter and Performance of Polyphase Induction Motors," by Theodore Hoock.

POLYPHASE INDUCTION MOTORS.

The theory of motor design has been thoroughly treated, but a rational method for determining the influence of rotor diameter upon performance has been lacking. The object of this paper is to determine the proper ratio of core length to pole pitch for which each item of performance is best. The subjects leakage coefficient, copper losses, overload capacity and iron losses are separately treated. The leakage coefficient is the ratio of the wattless component of no-load current to the current at stand-still. All the characteristics of the motor are improved by decreasing the leakage coefficient. Calling this coefficient "k" the maximum power factor is equal to $1/(1+2k)$. The leakage coefficient becomes a minimum when the total slot plus zigzag leakage is equal to the total end-connection leakage. The ratio of the dimensions of the pole face are worked out for values of D^2l of 300,000 and 2,000. The investigations show the opposing influence of pole-face proportions upon power-factor and losses, and that for every rating there is one ratio of diameter to core length for which the performance becomes a maximum. A table is given showing the ratio for which power-factor apparent efficiency, and copper loss assume the best values for given D^2l. Various other factors must influence the final design.

E. F. W. Alexanderson regarded this paper as a contribution of great value from the educational standpoint, but did not consider that it would be of much help to the designer, either in saving time or improving his design. He considered the leakable coefficient an unfortunate term to apply to the ratio of magnetizing current to short-circuit current, as this is one of the fundamental characteristics of a machine. Written discussion was submitted by S. Haar covering somewhat the same ground as Mr. Alexanderson and it was not read in full.

C. J. Fechheimer took exception to the author's statement that the dimensions of motors are not limited by the temperature rise, but by performance and flux-density. In designing twenty-five-cycle motors he had found that cost and temperature rise were the limitations in design. He favored smaller diameters and saw little value in the complicated formulas which had been derived.

H. Weichsel considered the results in the paper of fundamental value in the first lay-out of design. He favored the use of leakage coefficient rather than the leakage reactance in work of this kind. The ratios given by the author would be very helpful in giving a clue to the best design under any given conditions. He stated that the cheapest machine is not the one which uses the least material, but the one which makes use of the greatest number of standard parts.

Mr. Hoock closed the discussion by answering some of the objections which had been raised. He admitted that it was not strictly true that the temperature rise did not limit the design, but stated that other limitations kept the influence of heating in the background. He also spoke of the problems of ventilation and noise and stated that no means had been devised for predetermining of the latter.

The two final papers of the session were discussed together. J. R. Craighead presented the first paper, entitled "The Application of Current Transformers in Three-Phase Circuits." The other paper, by E. C. Stone and R. W. Atkinson on "The Cost of Transformer Losses," was presented by Mr. Atkinson.

CURRENT TRANSFORMERS.

The secondaries of two or three current transformers whose primaries are supplied from the lines of a three-phase circuit are frequently interconnected to save room, simplify wiring, and diminish cost. In this case the equivalent load carried by the current transformer secondary can not be determined in the simple manner that applies to an ordinary series connection, since the devices used in a series circuit may constitute a very different equivalent load when used in an interconnected circuit. An understanding of the equivalent load carried by each transformer is necessary in order to determine suitable limits of load from results of tests made in the ordinary manner. The term "equivalent load" is used to indicate the load carried by the secondary of a current transformer where this may differ from that obtained by combining in series the resistances and reactances of the devices used. In interconnecting secondary loads for current transformers, the load is placed in the form of a Y, the differences between the various interconnections arising from the various methods of connecting the transformer secondaries to the three load terminals. The following causes may change the equivalent secondary loads carried by the transformer without any alteration of connections: (1) change in the relative amounts of current in the primary lines; (2) change in the phase angle between currents in the primary lines. Variations of load due to these causes are unavoidable, and a reasonable margin should be allowed for their effect in planning an installation. The following causes control the amount of equivalent secondary load carried by the current transformers, and are the real basis for selecting combinations which will operate properly on three-phase circuits: (1) the amounts (volt-amperes or impedances) of the secondary loads; (2) the power-factor of each of these loads and the relation of these power-factors to one another; (3) the number and method of connection of the current-transformer secondaries. Consideration is given to each of the chief conditions arising from the above-mentioned variations.

Two transformers, straight and cross-connected, and three transformers star-connected, are considered. Unbalancing of primary currents has a general tendency to increase loads on interconnected current transformers, and where the circuit is known to be unbalanced to an unusual degree, interconnections should be avoided or the loads connected to the secondaries should be kept considerably below the amounts allowable under balanced conditions. The exact volt-amperes and power-factor of the equivalent loads of a two-transformer combination may be obtained from the formulas. The results for a three-transformer combination cannot be exactly calculated from the volt-amperes and power-factor of the separate loads, because the characteristics of the transformers themselves affect the division of the load among them. This circuit may be changed by the addition of a common return lead to three simple series circuits, whose volt-amperes and power-factor are easily obtainable. This is the better connection except where the load in one line is an overload for one transformer, when the interconnected combination divides the load in such a way as to relieve the overloaded transformer.

COST OF TRANSFORMER LOSSES.

The cost of the losses occurring in a transformer is of the same order of magnitude as the cost of the transformer itself and should receive the same amount of consideration. The elements of cost are: (a) iron loss, involving consumption of energy in transformer, station and line capacity to take care of such energy; (b) magnetizing current, involving copper loss in generator and line, generator and line capacity to take care of this magnetizing current; (c) copper loss, involving consumption of energy in transformer, station and line capacity to take care of such energy; (d) fluctuating secondary voltage, causing shortening of life of lamps. On account of the uncertain factors, the investigation can be only approximate. Magnetizing current and regulation are the new features not usually considered. The different elements are fully discussed, and it is shown that of the total cost iron loss constitutes 40 to 70 per cent, copper loss 30 to 50 per cent, magnetizing current 1 to 30 per cent, and regulation 1 to 10 per cent. Copper loss has a less cost than iron loss, due to shorter duration and to diversity factor. Cost of magnetizing current is the most variable factor, and is shown to be of considerable importance in many cases. In the appendix, formulas are derived for the different costs and a comparison made between transformers of low and high efficiency. The capitalized losses are shown to exceed the first cost, so that a saving of ten per cent in losses is of greater value than ten per cent reduction in first cost, and the high efficiency transformer is the cheaper. A discussion is given showing the general relation of the cost of the losses to the amount of material in the transformer. It has been found that for a given amount of material, as the ratio of the losses is varied, the copper loss of the transformer increases faster than the iron loss decreases, thus making the total loss larger, the larger the ratio of the losses. The amount of material in the transformer increases faster than the losses are decreased, when the losses are varied by varying the size of the transformer. For lighting transformers, the amount of active material varies inversely as more than the third power of the loss.

The discussion of these two papers was opened by A. H. Pikler, who stated that there had been little change in the design of transformers since the first installation twenty-seven years ago in Hungary. The changes that have been made in design were due principally to changing conditions such as the cost of labor. He considered the paper very valuable and thorough. As a low-grade transformer can be made very cheaply it is necessary to point out such facts as are contained in the paper to buyers, in order that they shall realize the desirability of purchasing good apparatus. He referred to the specifications issued by the Bureau of Standards as helping toward this end. It is the competition between manufacturers and not the demand of customers which stimulates improvement in design. He spoke of the relation of power-factor to core loss and pointed out how a high power-factor did not of itself indicate any superiority.

W. C. Smith submitted some written discussion pointing out that with the present grades of transformer, depreciation had been very much reduced, and that with the ever lessening cost of electrical energy this item was of very much more importance than operating losses. A change in life of ten to twenty years is equivalent to a difference of sixty-nine per cent in the cost. He thought that the near future would see a rise in operating temperatures. The maximum allowable temperature has already been increased from eighty to ninety degrees and would be likely to rise to 125 degrees if suitable insulating materials could be obtained.

E. A. Wagner thought that the value of the relations and formulas given in the paper would depend largely upon their proper interpretation. Magnetizing current is not proportional to core loss and in the example given by Messrs. Stone and Atkinson the difference in cost would be in the opposite direction if proper values were used. The tendency in transformer design is toward the use of higher flux densities.

H. B. Gear spoke from the point of view of the operating engineer. The monthly core losses in the system of the Commonwealth Edison Company amount to half a million kilowatt-hours, but with cheap power this was a small item compared to the life of the transformer and its depreciation. The present design of a transformer is different for power and lighting circuits, since the time in use differs widely in these two cases. A compromise is effected by picking out transformers which are suited to the average load-factor of the system.

Mr. Atkinson then made a brief reply and the session adjourned.

Industrial Power Session.

The industrial power session was called to order by President Jackson about three o'clock Wednesday afternoon. Without further preliminaries he called upon Arthur C. Eastwood to read his paper entitled "Control for Direct-Current Motors."

AUTOMATIC MOTOR CONTROL FOR DIRECT-CURRENT MOTORS.

Obviously the ideal arrangement for starting or reversing a motor is a starter that will do the thinking for the operator. In the case of any motor-driven machine or tool there is a maximum safe accelerating current which should not be exceeded. The ideal starter or controller should be so arranged that this maximum safe current cannot be exceeded. It should also be so arranged, in the interests of efficiency both as to current and to time, that the current during acceleration will be kept as closely as practicable up to the safe maximum value. Mr. Eastwood describes some recent developments in automatic motor control of the current-limiting type. The magnetic switches which control the acceleration are

series wound, and their windings are connected in series with the motor to be controlled. This type of controller is made possible by the development of a magnetically-operated switch. This switch acts not only as a switch for closing a circuit and holding it closed, but acts also a current-limit relay or so-called "throttle." If the current which flows through the winding of the switch is below a certain critical value the switch will close instantly, while if the current is above this critical value the switch will "lock out" or refuse to close till the current has been reduced to the critical value. Means are provided whereby the critical value of current below which the switch will close and above which the switch will lock out may be readily adjusted, thereby adjusting the accelerating current taken by the motor.

The discussion was opened by H. E. Murphy, who described a rugged form of motor control, the principal operating feature of which depends upon the elimination of contact points and the employment of a solid rolling contact surface, the action of the switch feature being controlled by a balanced magnetic pull. The switch member has a pivoted joint, the lever arm of which is acted upon by two paths of the magnetism engendered by the series coil.

Mr. Eastwood in reply to a question respecting whether the current-limit control he had described had been applied to alternating-current circuits, said that some experiments had been carried out and there was considerable promise of success.

The paper entitled "Limitations of Rheostat Control," by L. L. Tatum, was then read.

LIMITATIONS OF RHEOSTAT CONTROL.

Fineness of stepping over a wide range affects the size of the rheostat by increasing the watt-dissipating material, as well as by increasing the number of switching points. Coarse steps tend to cheapen the rheostat, but there are limits in this direction which will be discussed under contact limitations. When a generator is capable of voltages much above normal, a fixed step of resistance results in economy of wattage capacity in the rheostat without approaching the contact limits, protects the machine from excessive heating of fields, and prevents excessive voltage on the line. For use with automatic voltage regulators which require a wide range of generator excitation, coarse steps over most of the range with fine steps around normal, for possible hand regulation, reduce the size of the rheostat materially. Another class of rheostatic device very similar in its functions to the field rheostat is the lamp dimmer. Here the conditions are even better defined than for the rheostat, as the dimmer is connected across a constant voltage supply in series with a quite definitely known resistance. The same general limitations apply, however: The coarser the stepping the smaller and cheaper is the rheostat. The limiting features in resistance material appear in getting the current into it, and getting the heat out of it. Heat can be dissipated by radiation, by conduction and by convection currents. In the case of enclosed resistances it is almost entirely conduction from the wire to the exterior surface. In the majority of cases, the final disposition of the heat is into the air, the greater portion of this being by convection currents at ordinary temperatures, although at high temperatures, radiation plays a very important part. Since practically all of the heat from a rheostat must be carried away by the air the actual design for a given limiting temperature both of issuing air and of rheostat exterior must be based on the laws of ventilation. The highest efficiency occurs when for a given amount of resistance material the quantity of air passed through the rheostat becomes a maximum. Vertical flues are more effective than horizontal baffles. The higher the temperature of the flue the more rapid the convective air currents and the greater the permissible watts for a given top area. What shall we take as a limit? Pieces of paper, wood, cloth, etc., begin to char at about 225 degrees centrigrade, or 200 degrees rise above the usual room temperature. A 150-degree centigrade rise would then seem to be a safe point to choose for a limiting temperature. But this limit need only apply to the parts of the rheostat which may come in contact with external objects. With embedded rheostats this would mean the case. In the open type, the resistor itself would be measured. But where the resistor is provided with a frame and has screens to prevent the entrance of foreign combustible material into the enclosure, the temperature limit of 150 degrees rise should apply only to the top or hottest part of this frame. The interior heating surfaces or flues should be permitted, say, double this, or 300 degrees centigrade rise. There would then still be a considerable factor for unforeseen overload before reaching a red heat, which occurs at from 500 to 600 degrees centigrade.

There being no discussion the paper entitled "Control of High-Speed Electric Elevators" was read by the author, T. E. Barnum.

CONTROL OF HIGH-SPEED EEECTCIC ELEVATORS.

The service to be rendered by an elevator depends upon the number of passengers carried and the number of floors served; and is limited by the time taken by passengers entering and leaving the car, and the time required for acceleration and retardation, as well as the actual time spent in traveling at full speed. The speed and service varies in the different types of buildings, the elevator in the smaller office building being required to start and stop frequently, while in the larger office building high-speed express elevators must be employed as well as those serving every floor. Two types of electric elevators have been developed to meet these services; one, the worm gear drive with moderate speed motor; the other, the gearless drive with special slow speed motor. The worm gear drive is used with a winding drum for short rises, and with the traction type of hoist when the rise is large. While the use of the worm gear results in a loss in efficiency from the motor to the load, this loss can be reduced to a reasonable amount by a correct cut worm and worm gear, and the use of ball thrust bearings. The gear drive permits the use of a moderate speed motor of low cost, and high efficiency; and what is most important, with a wide range of speed control by field resistance. This speed control gives economical operation at a comparatively low speed and with certain classes of elevator service results in such an increase in electrical efficiency as compared to the gearless motor as to offset entirely the loss due to the gear drive.

Mr. Barnum emphasized the desirability of keeping the shunt field partially excited, as where the elevator had to be started quickly from rest, and frequent starts made, the time consumed in building up the field was considerable and the power input was also greatly increased if residual magnetism only was depended upon.

The paper by Wilfred Sykes entitled "Electrically Driven Reversing Rolling Mills" was read by the author.

ELECTRICALLY DRIVEN REVERSING ROLLING MILLS.

This papr. describes the application of electricity to reversing rolling mills and pays particular attention to the use of flywheels which store up energy in the case of rapidly fluctuating loads, improving the operation from the motor standpoint. The author considers the Ilgner system an ideal arrangement for a plant of this character, and tables are given showing the operating features of thirty-two mills of this type which have been installed or ordered in Europe and three in this country. With respect to the reason why reversing mills are used at all the author believes that when a mill has to roll a large number of different sections and operates only for a short time on one particular class of work, the two-high mill is much more convenient than a three-high mill, and the economy of the reversing mill with intermittent work is higher than that of the continuous running mill, principally on account of the elimination of friction load when the mill is not in operation. The paper also describes the control of roll motors, discussing the various features of control. Respecting the efficiency of the reversing mill, Mr. Sykes figures that under the most favorable conditions the steam-driven reversing mill will take at least fifty per cent more steam than an electrically driven mill. The paper describes the reversing mill at the plant of the Illinois Steel Company. The roll motors are operated from a motor-generator set consisting of a 1,300-horsepower induction motor, 6,600 volts, twenty-five cycles, coupled to a double-commutator shunt-type generator and two flywheels, each weighing 100,000 pounds. The synchronous speed of the set is 375 revolutions per minute, the peripheral speed of the flywheel being 15,500 feet per minute.

This paper was discussed briefly by G. A. Balling, F. G. Gasche. and R Tschentscher. Mr. Tschentscher made a number of very interesting points with respect to two-high mills and made the statement that to some extent the reversing mill plant of the Illinois Steel Company at South Chicago recently antedated anything that had been installed abroad. It was his opinion that the two-high mill had an advantage in its ability to be stopped instantaneously in case of trouble and its lower maintenance cost. It could handle a greater variety of raw products and turn out the largest amount of finished material. There was less roll friction and consequently less power necessary.

The further discussion, although desultory, indicated that there was a decided impression, among mill men, that the electric drive was surely taking the place of steam-driven mills, the resulting economy of the motor drive in the saving of power more than offsetting the high first cost of installation.

Educational Session.

The closing session of the convention was held under the auspices of the Educational Committee on Friday afternoon with Chairman Langsdorf presiding. A paper by Ralph D. Mershon, entitled "Tentative Scheme of Organization and Administration of a State University," was, in the absence of the author, abstracted by Prof. J. H. Hunt, of Ohio State University, in respect to which institution Mr. Mershon's efforts have been directed.

ORGANIZATION OF STATE UNIVERSITY.

A scheme of organization for a state university was drafted with the idea of provoking discussion which would lead to a revised workable organization. In the proposed scheme the president is the executive head of the university and has the necessary authority. He is the representative and general executive of the board of trustees and has the responsibility of enforcing all rules and regulations made by the board and by the faculty. He is also *ex-officio* chairman of the university council and of the faculty, but has no vote in either except in case of a tie. The university faculty is the legislative body in all matters relating to the conduct and control of the students. It is made up of the deans of the several colleges and of instructors of rank as high as associate professor. The university council is made up of the deans and, with the president, forms the executive body. The deans are appointed by the president and teaching is left optional with them. An alumni advisory board consists of alumni of ten years' standing elected by members of an alumni association. Its approval is necessary to appointments to any position in the university. It is also expected to appoint visiting committees to aid the various departments of the university by suggestion, advice and financial influence. A superintendent of grounds, reporting directly to the president, is responsible for buildings, grounds, power, heating, etc. Each college faculty has charge of minor legislation relating to its own college. A students' advisory board may bring matters to the attention of the president and on his request advise with the council, the faculty or the alumni board. Budgets are to be made up by each dean after consultation with the heads of departments and the council shall adjust these before presentation to the board of trustees.

The discussion was opened by A. H. Ford, who stated the three functions of a state university to be (1) the training of men and women for useful service; (2) the search for knowledge; (3) the dissemination of knowledge. The organization should be such as to best meet these ends. He approved the proposal for handling the budget, but thought that while the alumni board would be excellent it was not a feasible scheme. Any new plan should aim to overcome the present defects in organization which usually are divided authority as between pedagogic work and finances and the menace of politics in state boards and lack of feeling of trusteeship. Professor Ford then presented his own scheme of organization in which the board of trustees dealt only with the president, under whose jurisdiction were the secretary, treasurer, university council and university faculty. Under the university council are the deans of colleges and the deans of preceptors; the latter are designed to meet the requirements of supervision of students' activities, control of dormitories, etc.

C. Francis Harding considered the curriculum of study of greater importance than the scheme of organization. The latter might well be modeled after that of an industrial corporation. There was no standard which would suit the different conditions found in different places. He considered alumni advisory boards a good proposal, but thought the membership should be limited to four or five men who should act only in an advisory capacity and not have a veto power.

B. B. Brackett argued against strengthening the influence of the alumni. Such a scheme would encourage inbreeding. The proposed alumni board should not have too much power as alumni sentiment is not usually very progressive. He thought the administration could be better improved from the outside.

A. S. Langsdorf thought that the faculty had too subordinate a rôle in Mr. Mershon's scheme and the powers of the president and advisory board were too much exaggerated. One of the present troubles is that the president has too much power. He thought the curriculum generally needed attention rather than the methods of administration.

G. D. Shephardson considered the proposal inadequate at both ends of the organization. One trouble now is that state work is not sufficiently concentrated and there should be a greater unification among the different fields of activity. He considered that the alumni board should have only advisory power and not any appointive or veto power.

M. C. Beebe considered that one of the difficulties had been that the organization had not kept up with the rapid growth of the state universities. The University of Wisconsin is now trying a scheme in which there are two heads, one of these being a business manager who looks after only the material affairs of the university. He thought that faculties would usually like to be relieved of supervision of student activities, but did not know whether that was feasible.

After some brief remarks by Secretary Pope, P. M. Lincoln, who was the senior vice-president present, took the chair and adjourned the convention *sine die*.

Convention Notes.

The twenty-eighth annual convention of the American Institute of Electrical Engineers was opened by a brilliant reception and dance at 8:30 p. m., Monday, June 26. Among other entertainment features was the luncheon at the Western Electric Company's Hawthorne works and a visit to the Commonwealth Edison Company's power house on Tuesday, the Electric Club luncheon at noon on Wednesday, and a reception to the ladies at the Art Institute Wednesday afternoon. This was followed by a boat trip on Lake Michigan on the steamer United States. On Thursday a visit was made to the plant of the Indiana Steel Company at Gary, Ind., and luncheon was served for the ladies at the South Shore Country Club.

On Thursday afternoon Louis A. Ferguson gave a luncheon to the past-presidents of the Institute who were present. This was a most delightful affair.

The luncheon tendered the American Institute of Electrical Engineers by the Electric Club of Chicago was one of the most successful functions of the convention entertainment. The luncheon was given in the grand ball room and in the smaller ball room adjoining, and covers were laid for over 500 guests. During the repast there was a vocal and instrumental entertainment and the guests were extended the right hand of fellowship in a well chosen address by Homer E. Niesz, president of the Electric Club. Responses were made by Dugald C. Jackson, president of the Institute, and Gano Dunn, president-elect of the Institute. Mr. Dunn spoke very feelingly respecting the generosity of the Chicago people and the fine spirit of cordiality and open-heartedness which had been exhibited. He hoped that the spirit of broad-mindedness that was everywhere apparent would prove a lesson and that the members of the Institute would take away from Chicago and from the Electric Club luncheon a regard for this spirit which would pervade the work of the council and of the committees during the present administration and forever after.

Those present at the speakers' table included Homer E. Niesz, president of the Electric Club; Dugald C. Jackson, president of the American Institute of Electrical Engineers; Gano Dunn, president-elect; John F. Gilchrist, president of the National Electrict Light Association; the following past-presidents of the Institute: John W. Lieb, Jr., Charles F. Scott, Bion J. Arnold, C. P. Steinmetz, F. B. Crocker, T. C. Martin, Frank J. Sprague, S. S. Wheeler and L. A. Ferguson; Ralph W. Pope, secretary of the Institute; F. L. Hutchinson, assistant secretary; Geo. F. Sever, H. M. Wilson and A. A. Gray.

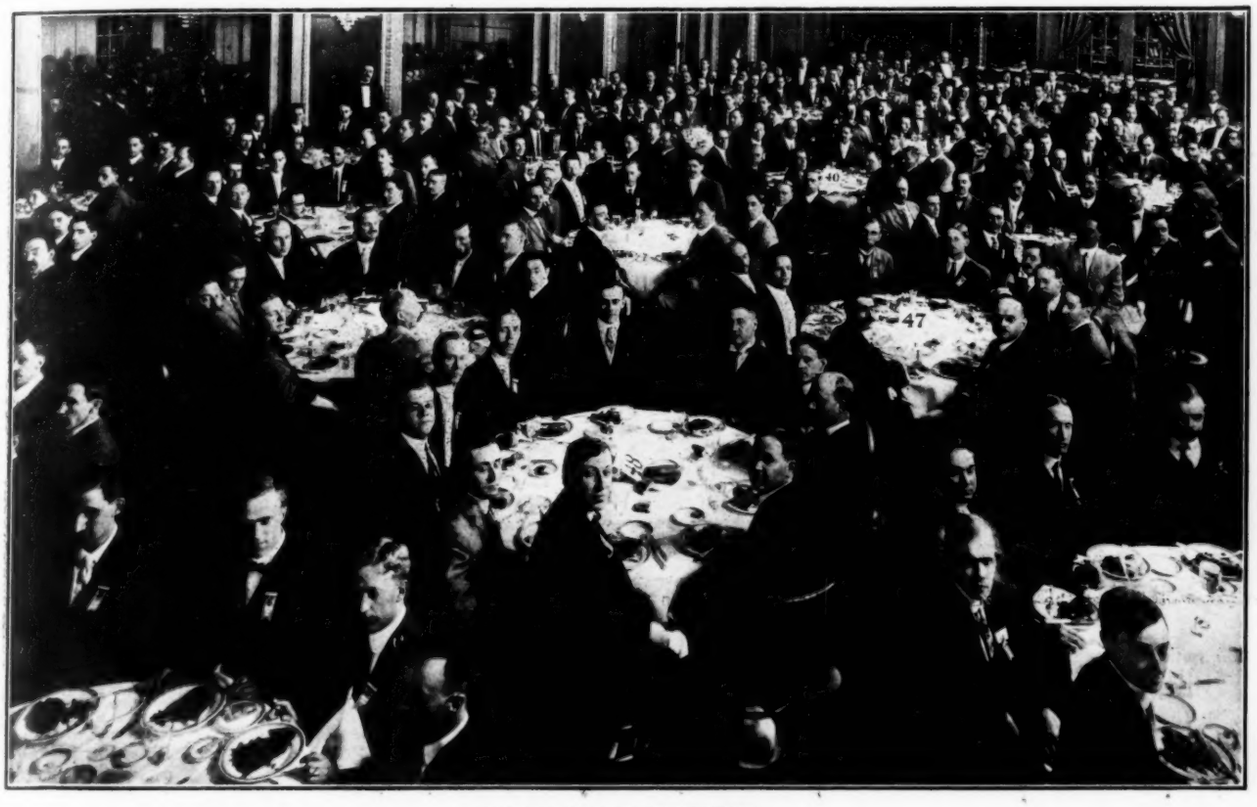
Tuesday afternoon was devoted to a circular inspection tour. A special Burlington train of six coaches left the Union Depot at 12:55 p. m. and carried the Institute members and guests to the Hawthorne works of the Western Electric Company. Here luncheon was served at 2 o'clock in the large dining room to the accompaniment of stirring music by the Western Electric Band. An inspection of the power house and several departments of the company's works was then made. At 3:30 p. m. the train was again boarded and carried the party to the main entrance of the Fisk Street station of the Commonwealth Edison Company. Small groups were formed, each in charge of a uniformed guide, who piloted his party through the boiler and turbine rooms, the new reactance compartments and the switch house. In a large tent on the lawn west of the switch house refreshments were served. Two boats were provided for taking the visitors across the river to the company's Quarry Street station, where other guides took the groups through this power station also. Recrossing the river, most of the party took the special train back to the Union Depot, although many returned by boat on the river, all reaching their hotels shortly after six o'clock.

On Thursday afternoon there was an excursion to the immense electrically operated works of the Indiana Steel Company at Gary, Ind. A special Lake Shore & Michigan Southern train of eight cars, provided by the General Electric Company, left the La Salle Street station at 2 o'clock and arrived at the works at 3:20 p. m. An inspection tour of gondola cars was drawn up alongside. To this the party transferred and was taken among many of the interesting features of the works, including the coke ovens, ore dock, blast furnaces, power house and open-hearth furnaces, thus giving the visitors an excellent idea of the great extent of the works. At 5 o'clock the party left Gary on the special train, on which refreshments were served during the return to Chicago.

A feature much enjoyed by those who were privileged to attend was the dinner given by Institute members of the honorary engineering fraternity, Tau Beta Pi. This was given in the Rose Room of the Hotel Sherman on Wednesday evening before the lake trip. Bion J. Arnold acted as toastmaster; brief addresses were made by Dugald C. Jackson, Gano Dunn, W. L. Abbott and G. D. Shepardson. Thirty-seven persons were present, including the wives of several members.

THE BYLLESBY DINNER.

One of the important functions of the convention week was the dinner given by H. M. Byllesby at the Chicago Club on the evening of Thursday, June 29. There are before the business men of this country, particularly those engaged in financing and operating public-service corporations, questions of the most vital importance, dealing with the relations of the company with its customers, involving the security of the investments placed in these enterprises, and in fact the ultimate success which shall obtain in this business.



ELECTRIC CLUB LUNCHEON.

This dinner brought together the leading capitalists and financiers of the City of Chicago and the engineers of the United States who have been most prominently identified with the developments of the electrical industry for the past thirty years, the heads of the large local dailies, the representatives of the leading technical journals and the operating managers of many of the most prominent central stations in the country. The table was beautifully arranged in a figure eight, the two loops having for

their picture pieces limpid pools of water in which gold fish flashed about and upon the surface of which floated many forms of electrically operated watercraft in miniature. Traversing the entire scroll of the figure eight was a miniature electric railway with the customary telegraph poles and wires alongside, supplemented by a miniature wireless telegraph station. Over the heads of the guests there floated a model of a Wright aeroplane and in one of the pools there was an electric fountain which flooded the room with colors of every description. The dinner service was elaborate and the favors were buds of American beauty roses.

Among those present were the following: Reginald Belfield, London; Samuel Insull, Chicago; Dugald C. Jackson, Boston, Mass.; Hugh M. Wilson, New York; S. S. Wheeler, Ampere, N. J.; Gano Dunn, Ampere, N. J.; F. B. Crocker, Ampere, N. J.; E. W. Rice, Jr., Schenectady, N. Y.; C. W. Stone, Schenectady, N. Y.; D. B. Rushmore, Schenectady, N. Y.: Frank J. Sprague, New York; B. E. Sunny, Chicago; M. B. Starring, Chicago; J. L. Woodbridge, Philadelphia; Francis Smith, Boston; George F. Sever, New York; C. F. Scott, Pittsburg; Paul Lincoln, Pittsburg; J. H. Finney, Washington, D. C.; A. A. Brown, Pittsburg; L. A. Ferguson, Chicago; P. Junkersfield, Chicago; T. C. Martin, New York; J. J. Abbott, Chicago; B. J. Arnold, Chicago; Frank Baker, Chicago; Horace G. Burt, Chicago; E. G. Cowdery, Chicago; Charles G. Dawes, Chicago; J. B. Forgan, Chicago; W. A. Fox, Chicago; W. J. Hagenah, Chicago; James C. Hutchins, Chicago; J. W. Johnson, Chicago; Frank Jones, Chicago; W. E. Kelly, Chicago; A. A. Gray, Chicago; H. H. Kohlsaat, Chicago; E. W. McKenna, Chicago; George M. Reynolds, Chicago; Reverend H. Page, Chicago; Theodore Robinson, Chicago; John C. Schaffer, Chicago; E. D. Sewall, Chicago; W. F. M. Goss, Champaign, Ill.; H. M. Byllesby, Arthur Huey, O. E. Osthoff, Harold Almert, J. S. Cummins, Elmer Dover, B. J. Fierlein, W. H. Hodge, R. S. Hunt, J. J. O'Brien, F. W. Stearns, W. R. Thompson and R. E. Wilsey, of H. M. Byllesby & Company.

After the repast was served, Mr. Byllesby, acting as toastmaster, called upon the Reverend H. Page, who invoked the divine blessing. Mr. Byllesby then said that his purpose in bringing this assemblage together was so that the engineers who had been responsible for so much of the development which had taken place in the electrical industry might get better acquainted with the financial men who were standing behind the inventions of the engineer and finding the money with which to continue these developments. Things were changing mightily today and business was being built up upon a scale which was far beyond the dreams of men a few years ago, but the great aggregations of capital and the large operating institutions were the natural outcome of the one-man firm and the simple partnership. It was necessary that the engineer, the capitalist and the people whom they would serve should all have a clear idea of their several responsibilities and it should be the purpose of all to manfully face the conditions as they present themselves today and work out a harmonious solution so that the best good could come to the greatest number.

Mr. Byllesby introduced Charles G. Dawes, who spoke very forcefully regarding the present business situation in general. It was indeed unfortunate that in the attempt to read the law out of the present statutes that the business world had been thrown into such an unnecessary turmoil. Spurred on by ambition and by the prospect of a fitting reward for unexampled courage in business, the men who had been responsible for the upbuilding of American industries had brought about vast manufacturing enterprises through periods of distress as well as periods of prosperity; they had unwittingly in many instances offended against the law; and when they had realized that their methods of doing business were repugnant to the statute they had changed this procedure, but this apparently was of little avail. So far as the business man in America knows today he is in danger of criminal procedure if he has in any way built up along well recognized lines a business of any magnitude. The rules laid down recently by the Supreme Court in the Standard Oil and American Tobacco cases do not indicate along what lines business might be pursued, but are more or less negative in character. They indicate what in some special cases may be construed as wrong, but they do not imply what is right. This applies to the small corporation as well as to the big corporation, and it is a crying shame that business men must be so hampered and business throttled because we do not know which way to turn.

Dr. Dugald C. Jackson, president of the American Institute of Electrical Engineers, was introduced and he felicitated with Mr. Byllesby upon the sentiments which had been announced respecting the desirability and necessity of engineers giving close attention to the leading of public opinion into a fairer attitude of mind with regard to the relation of the customers to the corporations which serve them.

George M. Reynolds spoke in a most optimistic manner of the indications that were everywhere present of the growing tendency of fair-mindedness upon the part of the public with regard to investments, both great and small. He was convinced that the American public was essentially fair-minded and intended eventually that there should be a square deal all around. The building up of large fortunes brought with it responsibilities and it was the part of men of large fortune and great influence to so conduct their affairs that there would naturally be a recognition of fair dealing on the part of the public.

In introducing Samuel Insull, Mr. Byllesby paid a glowing tribute to the high courage and splendid management which had made the Commonwealth Edison Company the pride of Chicago and of the central-station industry throughout the world. He fittingly remembered L. A. Ferguson and Mr. Insull's other associates in extending this modicum of praise.

Mr. Insull spoke very feelingly regarding the developments which have taken place during the last thirty years and paid high tribute not only to the engineers, but to the men of capital who had stood behind and made possible these developments. He emphasized the importance to the community of the centralization of power to the end that the cost of energy might be reduced to the minimum. So fortunate was the Commonwealth Edison Company in its control of the diversity factor that it could sell large volumes of energy in bulk and at a rate which was deemed impossible even under the most conservatively and well managed smaller operating organizations. The massing of large amounts of power in central-station plants will make the electrification of railway terminals a matter of easier solution because it will eliminate the great cost of building individual power stations for the individual railroads entering a community.

Gano Dunn, president-elect of the American Institute of Electrical Engineers, paid a delightful tribute to Mr. Byllesby and said that he considered the engineers and operating men largely in Mr. Byllesby's debt for bringing such an assemblage together and for exhibiting such an example of devotion to the common weal and evidencing so unselfish a spirit in his desire to do his part in working out the problem of the day.

The program of the evening was closed with some brief remarks by Bion J. Arnold, who explained some of the considerations which had resulted in the establishment of power stations in New York City for the electrification of the New York Central and Pennsylvania systems.

MEETING OF SECTION DELEGATES.

On Thursday evening a meeting was held by the delegates from the various sections, to which, however, all members of the Institute were invited. P. M. Lincoln, chairman of the Sections Committee, presided, and called the meeting to order about nine o'clock. The object of the meeting was to discuss Institute matters of interest to the Sections.

The Committee on Co-operation With Other Societies was first called upon for a report, which was presented by Chairman Hoadley. He was followed by Messrs. A. S. Langsdorf, of St, Louis; L. L. Tatum, of Milwaukee, and Earl Wheeler, of Washington.

Secretary Ralph W. Pope also spoke on this subject and on the probability of organizing a local section in New York City. He stated that after the current year he would devote his entire time to the sections.

President D. C. Jackson, who had arrived during the preceding discussion, then made an address, in which he told the delegates something of the inner workings of the Institute, the appropriations made for different purposes, including an increased allowance for the sections, and the aims of the Board of Directors. He referred to the resignation of Secretary Pope, which had been announced, and the desirability of amending the constitution so that the new incumbent of that office would be assured of tenure of office during good behavior.

S. G. McMeen then made a report for the Committee on Constitutional Amendments, and a resolution was passed asking the Board of Directors to resubmit at the next annual meeting the amendments which were defeated this year.

A. S. Langsdorff presented resolutions of appreciation for the work of the secretary, and they were adopted. Secretary Pope spoke, expressing his acknowledgment of this graceful act of courtesy.

As Chairman of the Committee on Elections, A. S. Langsdorf also presented a proposal for alterations in the method of conducting elections, but after a long discussion the matter was laid on the table.

President-elect Gano Dunn arrived late in the evening and made a telling address, having reference largely to the methods of conducting elections and the subject of electioneering. The meeting adjourned at midnight.

WIRE CORPORATION OFFICIALS INDICTED.

THIRTY-FIVE CORPORATIONS INVOLVED, INCLUDING MANUFACTURERS OF BARE, RUBBER-COVERED, WEATHERPROOF AND MAGNET WIRE.

The grand jury, United States Circuit Court, New York City, on Thursday of last week returned nine indictments against officers of the American Steel & Wire Company and thirty-five other corporations and partnerships in the steel and wire organizations which the federal authorities have been investigating. These indictments are found under the Sherman Act, and charge a combination and conspiracy in restraint of interstate and foreign commerce. The corporations and firms, as such, are not indicted, but eighty-three individuals operating through the alleged pools are involved as defendants in the bills which the grand jury handed to Judge Hand.

These indictments are all practically the same in form, and charge that the defendants in each one of the nine pools described undertook, with respect to the particular product, to establish an unlawful combination and conspiracy by arbitrarily fixing artificial and non-competitive prices in excess of the prices which would have obtained if the alleged combination had not been in existence.

The Government further asserts that the defendants in the several so-called pools undertook to limit the amount of product by each of them to an agreed proportion of a limited total output, for the purpose of destroying and preventing competition.

Edwin E. Jackson, Jr., of New York City, who is now in Europe, according to the tale of the indictments was the center of operation of these pools, under the title of "Supervisor." A set of rules were promulgated by the Supervisor, covering the ratio of any corporation's output to the total output of all the corporations during a given period of time. Then, according to the Government's charges, the pool members were required to report to Supervisor Jackson monthly the extent to which their business of the preceding month had exceeded the allowed limit, and for such excesses a certain remittance had to be made, determined in varying percentages, according to the agreements.

The indictment charges further that schedules of prices were fixed on a non-competitive basis, and that the members of the nine pools reported to Jackson every day the details of every shipment made, including the name of the customer, and, in case of contracts, the time of delivery. Jackson, the indictments charge, made up every day statements showing the total value of orders on hand and sent these statements to each of the corporations involved and was, in fact, a sort of clearing house for information for the members.

Many of the men named in the indictments are well known in the electrical field and of the highest standing. A number of them were seen and their opinions requested respecting these indictments. It is stated that no warrants will be issued for the arrest of any of the persons indicted. Counsel for the various corporations have notified United States Attorney Henry A. Wise that the defendants will appear at any time appointed for pleading. The penalty provided by the Sherman Law for the offenses charged is a fine of $5,000 or imprisonment not to exceed one year, or both.

A dispatch received from Ferdinand W. Roebling, the head of the John A. Roebling's Sons Company, of Trenton, N. J., one of the largest wire companies in the United States, stated that the indictments, which he had not seen, no doubt related to two arrangements, one of which was discontinued three years ago, and the other about two years ago. Mr. Roebling said that at the present time his company had no agreement of any kind with any other company or firm relative to prices or anything else.

These various agreements under which the indictments were found apparently all seem to have terminated—that of the Telephone Cable Association in January, 1910; the Weatherproof and Magnet Wire Association in November, 1909; the Magnet Wire Association in June, 1910; the Lead-Encased Rubber Cable Association in January, 1910; the Underground Power Cable Association in April, 1909, and the Rubber-Covered Wire Association about two years ago. It was stated that the members of the association met at luncheon at stated periods and talked over business and heard reports of what had been done. In some cases the organizations were so formed that they terminated at each meeting and were resumed at the next.

"The United States Attorney has instituted these proceedings for something that happened two years ago," said an attorney for the United States Steel Corporation, "and not for any wickedness that is going on at the present time. The agreements were made at a time when everybody was making them. But there is still a question whether those pools were within the law or not. This question has not been decided by the indictments."

It was further stated that it was doubted if these cases would ever come to trial, and that the one point involved was the legality of co-operation.

Prior to the forming of these associations, it was claimed the wire-producing companies in many instances were carrying on business at a loss, due to violent competition; and that these associations were formed so that a reasonable profit could be assured for both the large and small manufacturer. Through the operation of these agreements losses were changed to reasonable profits.

The indictments in the wire field are against the following, the quoted names indicating that the officers of the court were not certain as to the first name of the person meant.

Rubber-Covered Wire Association—William P. Palmer, Frank Baackes, George A. Cragin, Charles W. Bassett, Frank A. Keyes, Frank N. Phillips, "Charles" R. Remington, Jr., Henry A. Reed, Henry D. Reed, W. Boardman Reed, C. Edward Murray, Herbert L. Satterlee, Fred J. Hall, James B. Olsen, "Thomas" F. Ryman, "Henry" H. Ashley, John C. Bridgman, George B. North, James H. Sieberling, Robert W. Sieberling, Robert E. Lucas, Le Baron C. Colt, Fred L. Dunbar, R. Eccleston Gallaher, William H. Hall, Jr.; Herbert O. Phillips, W. Fred Fields, Ferdinand W. Roebling, "Frank" J. Newbury, Le Roy Clark, George B. Wilson, Charles A. Morse, James H. Mason, Joseph W. Marsh, William A. Conner, Philip H. W. Smith, Danna R. Bullen, Wallace S. Clark and Edwin E. Jackson, Jr.

Weatherproof and Magnet Wire Association—William P. Palmer, Frank Baackes, George F. Rummell, George A. Cragin, Frank A. Keyes, Charles W. Bassett, Frank N. Phillips, Eugene R. Phillips, "Charles" R. Remington, Jr., Alfred A. Cowles, Charles F. Brooker, Russell A. Cowles, Thomas Wallace, Jr., Louis F. Anschutz, Edward L. Frisbie,

Jr., "Arthur" M. Dickinson, Thomas B. Kent, "Thomas" F. Ryman, "Henry" H. Ashley, John C. Bridgman, Alfred F. Moore, Antoine Bournonville, Edwin Bartram, Edward S. Perot, George J. Jackson, Herbert O. Phillips, W. Fred Fields, Ferdinand W. Roebling, "Frank" J. Newbury, Joseph W. Marsh, "William" A. Conner, Philip H. W. Smith, Charles J. Marsh and Edwin E. Jackson, Jr.

Fine Magnet Wire Association—Ferdinand W. Roebling, "Frank" J. Newberry, Frank N. Phillips, Eugene R. Phillips, "Charles" R. Remington, Jr., Joseph C. Belden, Newel B. Parsons, Wallace D. Rumsey, William S. Kyle, Thomas Wallace, Jr., Louis F. Anschutz, Alfred F. Moore, Antoine Bournonville, Edwin Bartram, Benjamin S. Webb, "Frank" M. Potter, Jr., "Henry" A. Hammond and Edwin E. Jackson, Jr.

Bare Copper Wire Association—William P. Palmer, Frank Baackes, George F. Rummell, George A. Cragin, Dennis A. Merriman, Frank A. Keyes, Charles W. Bassett, Frank N. Phillips, Eugene R. Phillips, "Charles" R. Remington, Jr., Alfred A. Cowles, Charles F. Brooker, Russell A. Cowles, Edward L. Frisbie, Jr., "Arthur" M. Dickinson, Thomas B. Kent, James H. Doughty, Edward S. Perot, George J. Jackson, Ferdinand W. Roebling, Karl G. Roebling, Joseph W. Marsh, "William" A. Conner, Philip H. W. Smith, Charles J. Marsh and Edwin E. Jackson, Jr.

Underground Power Cable Association — William P. Palmer, Frank Baackes, Dennis A. Merriman, George A. Cragin, Frank A. Keyes, Charles W. Bassett, Edward S. Perot, George J. Jackson, Ferdinand W. Roebling, "Frank" J. Newbury, Joseph W. Marsh, "William" A. Conner, Philip H. W. Smith, Charles J. Marsh, and Edwin E. Jackson, Jr.

Lead-Encased Rubber-Insulated Cable Association—William P. Palmer, Frank Baackes, George A. Cragin, Frank A. Keys, Charles W. Bassett, Fred J. Hall, Ferdinand W. Roebling, Frank J. Newbury, Le Roy Clark, George B. Wilson, Everett Morse, Charles A. Morss, James H. Mason, Joseph W. Marsh, William A. Conner, Philip N. W. Smith, Charles J. Marsh, and Edwin E. Jackson, Jr.

Telephone Cable Association—Frank N. Phillips, "Charles" R. Remington, Jr., Edward S. Perot, George J. Jackson, Ferdinand W. Roebling, "Frank" J. Newbury, Joseph W. Marsh, "William" A. Conner, Philip H. W. Smith, Charles J. Marsh and Edwin E. Jackson, Jr.

The following editorial from the New York *Daily Globe* is an able review of the so-called Sherman Law and its scope.

The first thing that strikes the attention in connection with the indictment of eighty-four manufacturers and their employees is that the conduct alleged to be criminal occurred prior to 1909. It is thus an ancient mare's nest that is opened, not a fresh or existing one. It appears that the pools, assailed as illegal, were dissolved by their members on their own motion. It is a fair inference that as soon as there was realization that the law was perhaps being violated there was amendment of behavior. It is given to few men, if any, to understand what the Sherman law permits and what it prohibits. For years business men have been saying to their attorneys: "Tell us what we can legally do and what we can be debarred from doing?" The answers of the consulted lawyers have varied. Under these circumstances, and during a period of confusion and doubt, it hardly seems good policy to dig into the past and to base indictments on old facts. If a man did not mean to violate the law, and stopped what he was doing as soon as informed that it was of doubtful validity, he is hardly the stuff out of which criminals are made, even though it be subsequently established that his lawyer guessed wrong, and that, viewed in the light of further developments and applications of the Sherman law, he led his client into illegality.

The second thing that strikes the attention is that the Sherman law, if strictly applied, hits the small business man as well as the large. It has been the comfortable assumption of hundreds and thousands that it was only aimed at the big trusts and the big combinations of capital. The eighty-four indictments now returned are for the most part against small men, officers of corporations not known to the public prints. But the Sherman law does not mention either bigness or littleness. If strictly applied, according to plausible theories of its proper interpretation, it will be necessary to cast no small percentage of the population into jail. The men who have labor to sell join together into unions, and agree one with another not to sell their wages below a certain figure per day or hour. They are violating the Sherman law if their employments relate to interstate commerce—are making agreements in restraint of trade. The fruit growers in all parts of the country, not enjoying the way commission men have preyed on them, have joined together to market their produce co-operatively—have one agent who does their selling for them and thus lessens competition. Such co-operation is presumptively illegal. In every line and vocation one sees either conventional or express agreements made and respected that limit the theoretical freedom of trade. No one can predict what would happen in this country if the Sherman law, without equivocation or evasion, were universally enforced. The number of the indicted would probably exceed the number of the unindicted. We have on the statute books a law that is exceedingly dangerous because out of joint with the world as it now is.

The final thing that strikes the attention in connection with these indictments is the fact that they constitute another notice and warning that it is time to repeal the law and to substitute for it a rational statute of control. No other country is in the mess we are, because no other country is foolish enough to seek to prevent co-operation and to refuse to recognize that some limitation of competition is inevitable and desirable. What is needed is a law that will specifically draw the line between what is legal and what is illegal co-operation. We should, on the one hand, tell men what they may do, and, on the other hand, what they may not do. The law should be affirmative, and cease being solely negative. The system of general prohibition has failed, and it will the more injuriously fail the more attempt is made to enforce it. The laborer, agriculturist, and the small business man is as much under the condemnation of the Sherman law as the big trust, and this will indisputably be found out when all the district attorneys become busy and the grand juries roll out indictments to return which they are legally constrained.

Pending Electrical Legislation.

A bill has passed the United States Senate which will make it possible for Los Angeles to secure the right of way through the National forests necessary for the construction, operation, and maintenance of an adequate water supply, the maintenance of power and electric plants and telephone service, the city to designate within two years just what land it will require for this purpose, to be approved by the Secretary of the Interior.

An effort is being made to get a bill through Congress to transfer the signal corps operation of the Alaskan Cable & Telegraph System to the Post Office Department, to be operated as a part of that service, July 1, 1912.

It is proposed that a board of seven members shall be appointed by the President to prepare a comprehensive system of regulations to govern the operations of all wireless plants afloat and ashore, which come under the jurisdiction of the United States, the report to be submitted prior to December 1, 1911, and to have due regard to both Government and commercial interests. It is suggested that one expert should be appointed from each, the War, Navy, and Treasury Department, three experts representing commercial wireless-telegraph and wireless-telephone interests and one scientist well versed in the art of electric-wave telegraphy.

Electrical League Picnic.

The Electrical League of Cleveland held a picnic on July 1, special cars carrying the members to Willoughbeach Park, where the afternoon and evening were devoted to bathing, dancing, baseball and other outdoor attractions. An appetizing supper was prepared by the committee on arrangements, after which an address was delivered by John J. Sullivan.

MISSISSIPPI ELECTRIC ASSOCIATION.

THIRD ANNUAL CONVENTION AT GULFPORT, JUNE 20-22.

The third annual convention of the Mississippi Electric Association was held in Gulfport, Miss., June 20, 21 and 22. The headquarters of the Association were established in Southern Hotel, all meetings being held in the convention hall. The convention was a success from every standpoint, the attendance being double that of last year.

The first session was called to order by Vice-president Jack Abbot, shortly after 10 a. m., Tuesday, June 20, who explained that President Greenland had removed from the state and would not be in attendance. Judge J. H. Neville was then introduced and in a brief address welcomed the delegates to Gulfport and extended the best wishes of the city for a successful convention. Mr. Abbot replied on behalf of the Association; and after announcements relative to the entertainment features the session adjourned.

AFTERNOON SESSION.

At the afternoon session the paper by A. B. Paterson, entitled, "Relations of Employees to Company and Public" was taken up. In the absence of the author, Mr. Knight read the paper.

RELATION OF EMPLOYEES TO COMPANY AND PUBLIC.

Mr. Paterson stated in his paper that on analyzing the subject it suggested, first—the relation of the employee to the company. It is assumed that the party entering the service of the public-service corporation has first given thought to the possible future and has decided that the prospects are bright, providing he is successful in rendering satisfactory service. The question then comes up as to what satisfactory service is and how it should be rendered. Satisfactory service means, first, loyalty to the company; second, a thorough knowledge of duties and the diligent application to same; third, sufficient interest in the operation of the company to inform other departments of deficiencies of service and if necessary assist them in correcting same. Further there should be no hesitancy in making suggestions of any kind that would further the best interests of the company. The employee should remember that from the company he is receiving his livelihood and that upon the company's prosperity depends his. He should analyze his position and immediately begin to improve along the lines in which he is most deficient. Each employee should have a thorough knowledge of the conditions of the company franchises, of the city code, of what a corporation consists and its proper position with reference to the public. The second subject taken up by Mr. Paterson is the relation of the employee to the public. In this connection he stated that it is particularly important that every employee, from the office boy to the president, should realize that each one owes his employment to the public and should regulate his conduct accordingly. The company has been granted the privilege to perform an essential service from which its stockholders eventually expect interest on their investment. The antiquated idea that public sentiment can be disregarded or in any manner overlooked has long been outgrown. It is, therefore, essential that a study be made of the question of how to best administer to requests of the public and then adopt such measures as will accomplish the most satisfactory results. Some of the important duties which would tend to maintain friendly relations are as follows: (1) The pleasant reception of complaints; (2) the prompt handling of complaints; (3) the satisfactory adjustment of all complaints; (4) the true statement as to the cause of any deficiencies and when same can be remedied; (5), polite and intelligent replies to all inquiries. In conclusion the employee's duty to his company should be loyalty and competence diligently applied, which would mean satisfactory service rendered to the company. His relation to the public should be such that it will place the corporation which he represents in a better light with the public, and in so doing, will be a man most valuable to his employer.

William H. Gorenflo opened the discussion explaining the attitude of Gulfport Company towards the public. Particular attention is paid to complaints, the public being encouraged to notify the company of any disatisfaction or cause for complaint.

W. B. Moorman stated that closest attention is given complaints by the company with which he is connected and every complaint whether real or imagined, is investigated in a friendly manner.

C. Z. Stevens said that in Hattiesburg, the relations of the public-service company with the public have been materially improved since an antagonistic council had been superseded by the commission form of government.

W. R. Herstein spoke of necessity of granting concessions to persons making complaints even if the complaint was not always justified. He said it was better to lose the few cents involved rather than the good will of the customers.

J. H. McArthur, speaking of street-railway complaints, said that his company makes an effort to settle all injury claims promptly and out of court. This policy is also followed in Jackson, according to Mr. Abbot.

Following this discussion the paper by H. J. Mauger, entitled, "Electrically Heated Appliances" was read by L. Callender.

ELECTRICALLY HEATED APPLIANCES.

Through this paper, the author advised an enthusiastic exploitation of electric heating devices, stating that the bulk of heating device revenue comes from the residence customer, and will thus develop the residence business. Statistics show that residence business has been neglected, not more than fifteen per cent of the residences in the United States within reach of central-station service are connected. The author advises house-wiring campaigns, on the installment plan and in cooperation with the electrical contractors, stating instances where such had been very effective. In referring to the popularity of the electric flat iron, Mr. Mauger advised the sale of the small disk stove and coffee percolators, as these with the other devices, makes an attractive income and a diversified load-factor. Further, the progressive central-station man realizes that the more cords by which he can bind the public to him, the more indispensable his organization becomes to the community. Among the electrical devices that have special application in the South is the electric radiator. Two lamp luminous radiators are now available, taking 500 watts, which will fill the need of Mississippi climate in winter. The means for effecting the production of current consuming devices may be classified as follows: Personal solicitation; show-room display; private demonstrations; public demonstrations; display advertising; solicitation by letter.

S. M. Jones opened the discussion, outlining the campaign carried on in Laurel. He stated that the flat iron is the best seller and is an excellent revenue producer.

A. H. Jones, of McComb, also reported progress in the sale of flat irons, fully eighty per cent of the company's customers using them. He said that the prices of the other heating devices are too high to find a ready sale although the toaster and coffee percolator are used rather extensively. Mr. Jones described a campaign carried on with electric two-burner stoves. They were sold on thirty days' trial at list price, installed, on the monthly payment plan. As the city has no gas supply the sale of these stoves the summer months has been very encouraging. A special rate of five cents per kilowatt-hour is made for the business with ten per cent off for prompt payment. Mr. Jones also mentioned an installation of electric stoves in a cooking school which he thought would result in benefits to the company in future years.

D. H. Braymer asked Mr. Jones if two meters are installed where stoves are used. Mr. Jones answered that where a two-disk stove, or larger, is installed a separate meter is used and customers are allowed to use the heating circuit for flat irons and other devices, thus getting the benefit of a lower rate.

L. Callender stated that the electric toaster is the best seller in Atlanta, Ga. O. A. Acuff said that all electrical household appliances are being pushed in Meridian. An average of 3 or 4 irons is being placed every day.

W. B. Moorman explained that on account of the Vicksburg company's plant being reconstructed the new-busi-

ness department has been somewhat neglected, but of the many electric irons placed on trial, ninety-five per cent have been retained by the customers. Sewing-machine motors have also been successfully pushed in Vicksburg.

Experiences with flat irons and other domestic electrical appliances were recounted briefly by A. W. Starliper, W. F. Gorenflo and C. E. Reid.

WEDNESDAY MORNING SESSION.

At the opening of the session on Wednesday morning, Vice-president Abbot read telegrams from George F. Leake, Walter Castanedo and S. W. Greenland, expressing regret at not being able to attend the convention.

The first paper taken up was by Edmund Dreyfus, entitled, "The Steam Turbine."

THE STEAM TURBINE.

In opening, Mr. Dreyfus regretted that he was not able to prepare a paper on the subject and would therefore have to talk extemporaneously. The early history of the turbine was briefly reviewed, Mr. Dreyfus pointing out that turbines were brought out as early as 120 B. C. The first impulse turbine was introduced in 1629 but it was not, however, until 1895 that the first commercial Parsons turbine was introduced in this country. Mr. Dreyfus said that in this age where every tendency is toward greater efficiency the steam turbine naturally presents itself as the foremost claimant for consideration. The characteristics of the design and operation of the steam turbine were pointed out, Mr. Dreyfus emphasizing particularly its simplicity and economy. In conclusion the speaker referred to a number of photographs of turbine installations which he invited the delegates to inspect.

In reply to a request by D. D. Feris for a review of operating conditions in Europe, Mr. Dreyfus said that European countries were realizing more fully the advantages of the turbine and were employing them to a much larger extent than heretofore.

The paper by A. H. Jones, entitled, "Necessity of Commercial Department," was then presented by the author.

NECESSITY OF COMMERCIAL DEPARTMENT.

The development of commercial activities in Mississippi has been given but little attention. Most of the plants in the State started at a time when the commercial applications of electricity were but little understood and appreciated. The nature of the load in the early days was not as diversified as at present. Motors were little thought of, in fact a day circuit was found in only the largest towns; flat irons and electrically heated cooking devices were unknown; residence, store and street lighting constituted the entire business. The entire time of the manager was devoted to plant operation and outside construction work. As time has passed, however, certain standards have been set and the customers' wants increased. The increase in uses of electricity has caused no decrease in the burdens on the managers, for if he is fully alive, he is well posted on operation, accounting, new-business getting and the relationship between the company, the customer and the public generally. On account of these conditions, the manager is liable to neglect, through necessity, the new-business end of his duties. He will take what new business comes to him but will not have time to wage an energetic campaign, to get all the business legitimately belonging to the company would take up his entire time. This condition exists today in nearly all the larger towns in Mississippi. With one or two exceptions it is probably true that no consistent and successful new-business campaigns have ever been undertaken in Mississippi. By this is meant that no such campaigns have been given the sole thought of an able aggressive commercial man. The possibilities in any community have not been exhausted, it would therefore, seem that there should be the courage and conviction to pursue the possibilities until they are captured, for when these are accomplished, other opportunities will present themselves, so that an aggressive commercial department need have no fear of ever reaching the saturation point. Some of the latent possibilities that a good commercial department brings into active existence are motors, flat irons, electric signs, cooking and heating appliances especially where gas is not available. The commercial department enables the influence of the company to grow and creates a new impression of the purpose of the public utility.

W. B. Moorman opened the discussion saying that there were important features not touched upon in the paper, namely the co-operation between central-station managers and contractors and architects. Mr. Moorman explained that in Vicksburg cordial relations were maintained and the results were very gratifying. In practically every new house, as a result of this co-operation, modern wiring was installed.

O. A. Acuff emphasized the value of keeping in touch with present customers by personal calls. He also spoke of the necessity of making prompt adjustment of complaints.

S. M. Jones thought that the commercial department of a central-station company should be maintained entirely separate from the other departments, with a competent manager in charge.

Brief remarks were also made by J. Jumonville, E. E. Esslinger and C. Z. Stevens.

The meeting then went into executive session and the paper by Jack Abbot, entitled, "Economical Care and Maintenance of Street Cars" taken up.

CARE AND MAINTENANCE OF STREET CARS.

In considering this subject rugged and durable equipment is considered and divided into three sections: Electrical equipment, mechanical equipment, and car bodies with curtains, signs, etc. The equipment of a car hardest to maintain depends upon local conditions. In hot countries and along the coast, it is the bodies, in cities, with heavy grades, the electrical equipment. The mechanical equipment always needs attention; good lubrication must be secured, and the smallest gear and wheel wear looked to. Mr. Abbott referred to details of maintenance on the system in Jackson, Miss., stating that for economical maintenance of electrical equipment, he had found it necessary to train motormen very carefully and thoroughly. New motormen are found very expensive, not only through rough handling of equipment but through accidents. Improper acceleration is the worst of all abuses, affecting every part of equipment and car itself. In conclusion Mr. Abbott advised the following economical maintenance: Adopt rails heavy enough to keep the track easily maintained, depending on the weight of car, for light single-truck cars, 75 or 80 pounds, section tee-rail, continuous joints, creosote or cypress ties on straight track with white-oak ties on curves with tie rods to keep the rails from spreading and the curve from creeping. Standardize all switches and turn outs and allow no fast running over same. Standardize all equipment, motors, car bodies, trucks, axles and miscellaneous equipment. All overhead trolley should be put up 18 or 19 feet above the track and perfectly alined, with only enough tension on trolley pole to keep same in contact with the trolley. Trolley wire should not be stretched too tight as it will last longer and be less liable to break when there is six or eight inches sag between the spans. This will increase the life of the trolley wheels.

The discussion of the paper is not available for publication.

An interesting and instructive lecture on the "Economical Use of Light" was then delivered by H. K. Karstens of the Holophane Company.

The election of officers for the ensuing year resulted as follows: President, Jack Abbot, Jackson; vice-president, R. B. Claggett, Greenville; secretary-treasurer, A. H. Jones, McComb. The Executive Committee, in addition to the above includes: W. F. Gorenflo, W. B. Moorman, C. Z. Stevens and S. M. Jones.

The entertainment features included a reception and dance on Tuesday evening, banquet on Wednesday and numerous boat rides and sight-seeing trips.

Over Nine Thousand Members in the National Electric Light Association.

The brilliant and successful administration of W. W. Freeman, as president of the National Electric Light Association, came to a close June 30 with a total of no less than 9,214 members. He began his term with a total of 5,736, which would give a gain of 3,478 for the twelve months. This is, of course, unprecedented in the annals of engineering bodies, but it is believed that the coming year under President Gilchrist may see the figures matched, as there is a strong movement on foot in all parts of the country toward the formation of company sections and the affiliation of state associations. There are indications that the membership during the coming year will easily reach not less than 12,000.

Electrical Notes From Great Britain.

By Our London Correspondent.

Notwithstanding a good deal of evidence to the contrary, agitators among colliery employees have spread abroad the idea that electricity was to blame for the colliery explosion at Hulton last December. The men's prejudices which had arisen out of previous disasters when the actual cause was clouded in mystery, could of course be easily played upon. It is, however, greatly to be hoped that the plain statement contained in the report of the Government Inspector of Mines will have the effect of silencing disturbing tongues, for as the result of his very minute investigation Mr. Redmayne says: "I am perfectly satisfied that the use of electricity in the mine had no bearing on the disaster." It is admitted that there were certain deficiencies in the installation which might have been remedied, and the inspector also regards it as unwise to use electricity at the coal face in a gassy mine, but the electrical plant was found to be generally speaking electrically and mechanically strong, properly erected, and well maintained. The condition of the armored cables used throughout the Hulton mine is regarded as a very convincing argument in favor of their use. It was found that they had satisfactorily resisted the effects of the heat, explosive blast, and heavy falls of ground, and in every case after the disaster they were mechanically and electrically perfect. From the evidence heard at his inquiry, Mr. Redmayne draws, as the chief conclusion, the importance of the proper supervision of the electrical plant. A mere daily statement that the apparatus is "good" he does not regard as sufficient; to be of any value it should describe how the plant was or was not enclosed at the time of the inspection, the level of the oil in the oil-immersed switch, and, among other things, should allude to the continuity of cable armoring. Such suggestions as these point once more to the oft-demanded "competent man" for making such inspections and reports. Mr. Redmayne adds: "However well-designed the apparatus, its safety may still be dependent upon constant supervision and efficient maintenance."

One other matter must not be passed over in mentioning this report. A safety lamp having been the cause of the explosion in the Hulton pit, the possibility of replacing existing lamps with electric safety lamps comes in for attention, and the advantages and disadvantages of the latter are summarized. The greater weight of the electric lamp, trouble with batteries, greater first cost and working cost, are three of the disadvantages, a fourth being the impossibility of detecting the presence of gas. The advantages of the electrical lamp, briefly stated, are the elimination of the risk of ignition of an explosive mixture, and the better light given, the latter quality permitting a better examination of the roof and sides. Of special interest in this connection is the offer, recently announced, of a prize of $5,000, by an anonymous colliery proprietor, for the best electric miners' safety lamp invented and submitted by the end of the present year. The competition is open to persons of all nationalities and it will no doubt act as a stimulus to workers in this department of electrical research and invention.

The need for industrial banks to assist British firms in securing electrical business abroad in competition with Continental organizations has again been expressed. T. O. Callender, managing director of Callender's Cable and Construction Company, says that he and his co-directors are convinced that some bank or financial association is necessary for British electrical firms if they are successfully to meet the powerful influences that continental concerns are able to bring against them. He hinted that later on his company might seek shareholders' assistance in setting such an institution on foot. It might be imagined that the British firm named is short of business, but such is not the case, its several factories being fully employed, while the outlook for cable orders in England has brightened by reason of the improved position of electric supply and power companies generally. Again the prospects in South Africa were considered to be exceedingly good, notwithstanding the loss of British business owing to the financial arrangements existing between the Victoria Falls Power Company and German electrical manufacturers. Mr. Garcke, chairman of the Brush Electrical Engineering Company has also been referring to the revival that has lately taken place in British electrical engineering. He appears to lay a good deal of the blame for the reckless competition and price-cutting of the last few years at the door of those who put down extensive new factories in anticipation of a big demand which has never come. A number of well known firms are at present working out schemes for rearranging their share capital. In my last month's notes I referred to the promised action of the British Westinghouse Electric Company, and among other concerns which have just announced similar intentions are the Brush Company and the British Electric Traction Company.

Brighton being the meeting-place of the Municipal Electric Association for this year (June 27 to 30), and as J. Christie, the president, is the chief of the electricity supply undertaking there, more than usual interest attaches to the report oi the year's working of the system, just issued. Mr. Christie has been engaged upon alterations to the high-tension switchgear, the piping arrangements, and repairs to the sea defences at Southwick station, with the result that there is a considerable addition to repairs and maintenance charges. In all departments the demand has shown increases, and in respect of lighting supply the low-water mark brought about by the general use of metal lamps has been passed. Mr. Christie is alive to the increasing importance of developing heating and cooking business, for a new field, he says, has been opened by the great improvements that are being effected in apparatus for these purposes. Brighton is a non-industrial town which has little assistance, comparatively speaking, from motor load, but there are 210 motors out on hire, aggregating 1041 horsepower. Respecting the alterations mentioned above, the high-tension switchgear has all been transferred from the engine room to the space provided for it in the office building. This difficult feat was carried without either accident or

interruption to the supply. Both safety and simplicity of operation will result from the change. Mr. Christie urges that the reserve fund of his department should be built up without delay, in readiness for heavy demands coming in the near future for the repiling of the quay wall, and for keeping pace with the great strides that are being made in the art of turbine design.

Turning now from his observations as borough electrical engineer of Brighton, the address of Mr. Christie to the Municipal Association claims attention. He took his hearers back to years ago when the Brighton electric supply system, prospering under Arthur Wright, changed its two-wire system over to three-wire, high-tension single-phase, alternating current being again introduced to meet the demand in the outlying area at times of peak load; later the voltage of the supply in these districts was doubled and the continuous current once more displaced the alternating. "In 1905 the North Road works as a steam generating station was superseded by the new three-phase turbine waterside station at Southwick, and the nuisance from a large works in the center of the town was thus removed. The old works are now only used as a substation, probably one of the largest of its kind in the United Kingdom, containing upwards of 8,000 kilowatts of converting plant of various types. To meet the continually increasing demands in the outskirts of the town, we will shortly have to again establish sub-stations, either equipped with three-phase alternating current plant, or self-contained engine units of the internal combustion type. Thus history repeats itself."

As Brighton is the home of the maximum-demand system it was very fitting that the president should refer to the question of rates. Engineers were generally agreed that the maximum demand was the most equitable from both the consumers' and suppliers' point of view, and for fixing prices for large lighting and power contracts it must still always form the basis of reckoning. Even in Brighton, however, where it was first evolved, it became unpopular with the majority of their consumers, and they found that by insisting on retaining it they were steadily losing good business, so in deference to the popular demand for an easily-understood flat-rate, they granted the concession. Fortunately the change came into force just as the metal lamp came into general use, and "today everyone is satisfied with the result." Arthur Wright some months ago expressed to Mr. Christie his belief "that we might ultimately come to a fixed charge per square foot of floor area on the basis of a given number of watts per square foot, have no meters, and allow consumers to use the supply for any purpose without other restriction." Among other points, the president mentioned electrically operated bakers' ovens as a class of business well worthy of investigation now that they are a commercial success. They make demands according to size of from 25 to 100 kilowatts, and are usually only wanted between, say, 11 p. m. and 6 a. m., when the station plant and mains are otherwise comparatively idle. The first cost and cost of maintenance are by no means prohibitive, and the business could be done at one cent per unit, which would effectively compete with the existing methods of heating these appliances, while the advantages of cleanliness and ease of regulation were all in favor of electricity.

The annual report of the Electrical Inspector of Factories (G. S. Ram), contains a good deal of interesting matter regarding the application of the new regulation relating to the use of electricity in factories and workshops. These came into force in January, 1909, but in spite of all the attention that the regulations received in the technical press, and in electrical circles generally, there have been plants and installations put in by consulting engineers, and even by well known contractors, who informed the inspector that they had never seen the regulations. Remembering how general and how detailed was the discussion of these regulations, both before and after they took on their final shape, it is remarkable that there could be an electrical man in the British Isles who would plead such ignorance. So it is, however, according to Mr. Ram, and it is the occupier of premises who is held responsible for the non-compliance of his installation with the usual government rules.

Reporting generally, the inspector says that while more accidents causing burns occur with direct-current apparatus, the fatal shock accidents are nearly all with alternating current. On the point which received some attention some months ago regarding the employment of non-electrical carpenters and bricklayers in electrical stations, Mr. Ram says that if work has to be done under conditions where there is danger "it is only fair that a competent electrical engineer or other person with adequate technical knowledge should undertake it." If it is necessary to employ non-electrical workmen near live conductors, "the live conductors must first be so screened off that there is no danger." Respecting electrical accidents in electrical generating and sub-stations, these numbered only forty-five as compared with fifty-eight and seventy-six in the two previous years.

Only four among all these cases were fatal. The improvement indicated by these figures is considered to show the existence of a higher standard of safety as regards the plant and apparatus, and greater care on the part of the operator.

The Leeds & Bradford trackless trolley system was opened with the usual public ceremony, which was held on June 20.

The Institution of Mechanical Engineers will hold a summer meeting in Zurich and northern Switzerland, beginning on Monday, July 24. Numerous power stations and other works are to be visited and the papers to be read will cover such subjects as railway electrification, experiments with Francis turbines and tangential (Pelton) turbines, new types of dynamometers, Diesel oil engines, etc.

ALBERT H. BRIDGE.

London, June, 1911.

New York Subway Award.

The Brooklyn Rapid Transit Company was awarded thirty-four miles of the new rapid transit lines at a special meeting of the Board of Estimate. The Company was given until July 6 to state whether it would accept the lines rejected by the Interborough Rapid Transit Company.

Borough President McAneny stated that Col. T. S. Williams, president of the Brooklyn Rapid Transit, has pledged his company to the construction of these lines. Likewise, Mr. McAneny said, both President Williams and the Brooklyn Rapid Transit bankers had verbally agreed to the terms for the operation of the entire railway system.

Electrical Notes from Continental Europe.

By Our Paris Correspondent.

The new Eiffel Tower wireless station is already beginning to send messages, although the plant is not as yet fully equipped and only a low power is employed at present. It will be remembered that the post is entirely underground, and it has a number of rooms built around a central court which is open so that the aerial wire can be brought down and anchored on the ground. For the aerial proper there are used six steel cables brought down from the top of the tower to a set of concrete pillars lying in the Champ de Mars grounds. At a point above the tower there is a wire taken off each of the cables, and the wires come together and are brought down into the station where they are grounded by large zinc plates. The wave length of the aerial system is about 2,000 meters. In the various rooms are installed the apparatus, part of which is temporary and will soon be replaced so as to give the station a high power. Two methods are now used, one of these being a seventy-five-horsepower plant using ordinary sparks and the second a special outfit for musical sparks. This latter includes of a resonance alternator on the Bethenod system, and although it uses but ten horsepower it can signal to long distances, and it is claimed that it will cover four or five times the distance obtained with the usual apparatus. The present plant was laid out by Major Ferrié, who is chief engineer of the military wireless department. It is intended to install a Diesel oil-engine group of 300 horsepower before long, so as to be able to operate the plant at high power.

The $30,000,000 project for changing over the suburban lines of the West State railroads in the suburbs of Paris to the electric system is now taking definite shape, and there seems to be no doubt that it will be carried out. A meeting of the various officials interested in the matter was held quite recently, and the plans which were presented by the railroad engineers were approved along their general lines. This will involve a very extensive piece of work, as the total length of the suburban lines reaching as far as Versailles and covering a well-populated region, is no less than 130 miles of track. It is intended to use the third-rail system, following the general practice of the city subway, and running trains made up of motor cars and trailers at intervals of three to five minutes, at least on the inner part of the network. The zone system will be used, with three zones, and the trains for the outer zones will not stop in the inner districts, so that the trains can be run at higher speed in this way. It is also intended to build twenty-five miles of new track to add to the above. The cars will resemble the Metropolitan subway type, but will be much larger, and will carry 200 passengers, seated and standing. The St. Lazare city depot will be transformed so as to provide the proper terminal facilities. As a result of the present meeting, the Commission pronounced unanimously in favor of the present project, and it desires to have the work commenced as soon as possible.

At St. Petersburg is installed an ozonizing plant for purifying the city water, and it has been in successful operation for several months past. Similar ozone plants are already running in a number of European cities, among others at Wiesbaden and Paderborn in Germany and at Nice and Chartres in France. New plants are also to be installed at Paris and also at Chemnitz and Florence. Regarding the St. Petersburg plant, it consists of motor-driven elevating pumps for raising the water of the Neva, filtering basins, and the ozone plant proper. After passing through rapid Howatson filters, the water is sent into treating towers, where it is mixed in spray with ozonized air. Current is provided by three engine and dynamo sets of 200 horsepower each. The present plant is installed by the Siemens-Schuckert and Paris Ozone companies in common.

Quite an extension is to be given to the central tramway station at Budapest, and there will soon be installed two steam turbines and alternators of the 10,000-horsepower size, and on the three-phase system. This will bring up the total output of the plant to 30,000 horsepower. The rolling stock will also be considerably increased, and 120 motor cars have been lately ordered. Each will carry two seventy-five-horsepower motors, so as to be able to run easily on all the grades of the lines.

It is stated that Engineer Franz Fischer, of Berlin, has succeeded in perfecting a process for obtaining very pure electrolytic iron. The object is to manufacture such iron on a commercial scale, and for various reasons this problem is a difficult one to carry out in practice. He is now applying it in a large establishment at Leipzig. The iron is deposited on the electrodes in the form of sheets, which are very solid and can be readily worked. Such iron is in a very pure state. Using other electrodes, iron tubes or various shapes can be obtained. The present iron appears to have remarkable magnetic properties, owing to its purity, and it has more rapid changes in its magnetic state, so that it is likely to be valuable wherever laminated iron is needed for electrical work.

Some interesting experimental work is being carried out by the Paris-Lyons-Mediterranean Railroad Company on a section of its tracks in the south of France. A special electric locomotive is under trial upon the electrically-equipped line and it has a number of features which are out of the usual order. The locomotive is designed by Messrs. Auvert and Ferrand, engineers of the company, and it runs on the single-phase system. The double-track line is fitted with catenary-suspension overhead wire. A novel point is the use of a motor-generator set on the locomotive, which converts the single-phase current to direct current, this latter being used upon the car motors. The present locomotive is made up of two half-locomotives coupled together. Each portion is mounted on double trucks so that the locomotive as a whole is an eight-wheeler. Two transformers are used. One of these gives current to a synchronous motor, and a second transformer furnishes current to the convertor itself, to be converted into direct current. The voltage of the direct current is changed by shifting the brushes upon the rectifier, this being done by a small electric motor device. The overhead line works at 12,000 volts, twenty-five cycles, and two pantagraph trolleys are used. During the tests with heavy trains on the short experimental

section, the locomotive worked very satisfactorily, and it is intended to build a second one embodying the same principles with a number of improvements. The direct-current motors on the trucks are mounted crosswise and have bevel-gear drive, being six-pole 400-horsepower motors working at 300 volts. It is now desired to obtain a locomotive of simpler construction and lighter weight.

According to the most recent data, there is now installed no less than 475,000 horsepower in machines in hydraulic plants in France. The minimum figure for the power given by the plants is 180,000 horsepower, and this corresponds about to the relation between low-water and high-water stages. Of the 475,000 horsepower there is used 210,000 horsepower for electrometallurgical work; 155,000 for light and power; 60,000 for chemical products; 30,000 for paper industries; 10,000 for traction, etc. The largest amount of current is for aluminum, steel and iron industries. When the newly projected plants are built, the above figures will be greatly increased, as the new plants will generate 720,000 horsepower, thus making a total of 1,200,000 horsepower, not including the work which is to be carried out on the Rhone River. Most of the hydraulic plants lie in the Alpine region in the west and south of the country. The Durance River alone is to furnish 400,000 horsepower from new plants.

A. DE COURCEY.

Paris, June 17, 1911.

Papers to be Presented at International Electrical Congress at Turin.

In addition to the official subjects for discussion at the Turin Congress, the invited speakers for which were given in our last issue, there will be a number of papers presented upon the initiative of their authors. The following have already been announced:

"Electricity Meters for Multiple Tariffs," by Jules Neher, Geneva, Switzerland.

"The Limit to the Application of High Tension in Mines," by Elvio Soleri, Turin, Italy.

"On Some Methods of Preventing Excessive Internal Voltages," by Alberto Dina, Palermo, Italy.

"The Electromagnetic Phenomena which Result Upon Short-Circuiting an Alternator," by P. Boucherot, Paris.

"Series Transformers," by Dr. Hallo, Karlsruhe, Germany.

"Aluminum for Electric Conductors," by Huber Stockar, Zürich, Switzerland.

"Automatic Regulators," by J. Routin, Lyons, France.

"Commercial Apparatus for 100,000-Volt Service," by S. Q. Hayes, Pittsburg, United States.

"Induction Electrodynamic Wattmeters" and "A Solution of the Problem of Rational Rates for Electrical Energy," by Riccardo Arno, Milan, Italy.

"Electric Traction with Respect to the Exigencies of Railroad Service," by Pietro Lanino, Rome, Italy.

"On the Construction of Apparatus for Single-Phase Ship Propulsion," by W. Kummer, Zürich, Switzerland.

"Applications of Electric Traction to Suburban Lines with Special Respect to High-Tension Direct-Current Systems," by Guillaume Gyaros, Budapest, Austro-Hungary.

"Progress in Electrical Installation in Japan," by Osuke Asano, Tokyo, Japan.

"The Technique of Electric Accumulators with Special Reference to the Nickel-Iron Alkaline Battery," by J. A. Montepellier, Paris, France.

"The Present State of the Question of Sterilization in Combination with Central Stations," by Etienne de Fodor, Budapest, Austro-Hungary.

"The International Outlook in Scientific Illumination," by Leon Gaster, London, England.

"Researches in Wireless Telephony," by Q. M. Calatabiano, Rome, Italy.

"The Rotating Electric Current Field," by A. E. Kennelly, Cambridge, United States.

"The Electrotechnical Industries of America," by T. C. Martin, New York, United States.

"Electrification of Railways," by C. O. Mailloux, New York, United States.

Duluth Electric Club.

An electric club has lately been organized in the towns bordering on Lake Superior, embracing the electrical fraternity in Duluth, Minn., Superior, Wis., and the surrounding territory. The officers of this club are: president, T. W. Hugo; vice-president, William H. Winslow; secretary and treasurer, J. B. Crane. Several successful meetings were held before adjournment for the summer, and they will be continued in the fall.

LETTER TO THE EDITOR.

Gas and Electric Street Lighting.

To the Editor:

The letter of your able correspondent under date of June 10 does not cover all of the points at issue and as your readers should have the benefit of both sides of an argument, let us see whether the statements in the original article published May 13 are correct. The large high-pressure gas units using three mantles show a duty of from 50 to over 70 mean lower-hemispherical candles per cubic foot of gas, the gas consumption ranging from 75 to 90 cubic feet per hour. Units of from 1,500 to 4,500 candles are in use abroad for public lighting.

Regarding the gain in efficiency due to grouping, it is necessary to have both a stock and a closed globe and practically all inverted arc lamps are so equipped. These lamps do show an increased efficiency over the single units.

The tests referred to on gasoline, not gas street lamps, as given, have been contradicted by Mr. J. R. Cravath (see *Electrical World*, June 22, 1911). It is also important to note that the lamps tested were in use under a contract calling for sixty nominal candlepower and that under a new contract calling for actual candlepower the lamps have performed up to standard. This latter form of contract has already been advocated by the writer and it would be well for the gas and electric interests to come prepared to furnish measured candlepower to the progressive cities who will ask and pay for their street lighting on this basis.

ENGINEER.

New York, N. Y., June 27, 1911.

Ohio Lighting Merger.

The Warren Water & Light Company of Warren, O., and the Hydro Electric & Gas Company of the same city have sold their holdings to the Trumbull Public Service Company. The latter company has, in turn, filed a mortgage for $1,500,000 to provide for the payment of bonds.

The Warren Water & Light Company, with its predecessors, has held the water franchise in Warren for twenty-five years and was only recently granted a new franchise for both light and water. The Hydro Electric & Gas Company was organized some five years ago by the late E. W. Gillmer.

CENTRAL-STATION PRACTICE

Transmission—Interior Wiring

MODERN WIRING PRACTICE.[1]

BY J. W. BEAUCHAMP.[2]

The growing experience of the public with regard to the cost and advantages of electricity supply is easing the work of the business-getting departments and bringing the supplier rapidly to the last barrier which must be overcome before the use of electricity can become general. That is the difficulty of introducing electricity into premises where, on account of cost, there is a disinclination to install the necessary wiring and fittings, although the supply may be desired and its economy well understood.

Doubts have been expressed as to the probability of small consumers being remunerative; certainly such business is of a special character, but on account of its possible magnitude and the comparatively high load-factor of lighting supply to private houses it deserves special treatment, more particularly as the growing demand for electric street lighting makes it necessary to lay cabl s in roads where only the smaller consumer can be obtained. The extent of this potential business is emphasized by returns which show that the proportion of premises taking electricity supply varies roughly from five to twenty-five per cent, according to the character of a community, age of the undertaking, competition, etc., whilst the percentage of houses rented at less than $150 per annum ranges from forty to seventy per cent of the total, again depending upon the wealth and occupation of the people.

The great bulk of this lightning business can be obtained in time either by means of:—

Prepayment meters; contract rates; or the usual monthly accounts according to the class of consumer, but the premises must be wired in exchange for a slightly increased supply rate, or on very simple and easy installment terms.

This is largely but not wholly a problem of policy and finance for the supplier; a suitably designed system of wiring would do much to assist in its realization, and it is the object of the writer to draw attention to, and, if possible, to cause discussion of, the features of modern wiring practice and regulations in so far as they influence the cost of small installation work.

WIRING REGULATIONS.

Although the rules of the Institution of Electrical Engineers are adopted by most British supply authorities there still remain so many exceptions and amendments that no real standard can be said to exist and there is great lack of uniformity in the quality of electrical installation work within any particular supply area, regulations being observed in the better class work and evaded or only complied with in a perfunctory manner where competition brings down the price of wiring. Against this tendency the supply authority can only struggle with difficulty as the general run of small house and shop wiring usually falls to the lowest bidder, and in many cases there is not the most elementary form of specification to insure that the several offers are based on the same requirements. This has a demoralizing influence on those who bid for the work, apart from questions of material and workmanship, in many instances they do not allow for a proper arrangement of fittings to secure economy in use for fear that a more meager scheme at a lower price should be accepted, the builder or the occupier being seldom able without advice to appreciate the greater value which may be offered for the higher price.

To enforce regulations in detail without obstructing work and progress is a comparatively expensive matter, requiring experienced and conscientious inspection and a decided sense of proportion on the part of the inspector.

The proper course oppears to lie in drafting simple and definite rules dealing with (1) safety of the consumer, and (2) non-interference with the proper working of the supply to other consumers, the requirements of these regulations to be made as light as possible but the enforcement of them to become more stringent.

A change in this direction should secure greater uniformity of work, tending to lower the cost of high-class wiring and force up the quality of the lower-class work, as in the latter almost all the trouble arises from insufficiently skilled labor, it being obvious to anyone whose duty it is to inspect wiring work that the employment of competent and full priced wiremen would frequently reduce the prime cost of jobs, and save good material from being reduced to a second-hand condition before it is even put to work.

Many of the existing rules are directed towards securing for the consumer a well designed installation, with regard to capacity of conductors, sectionizing, etc. As these cannot be enforced, and their value depends so much upon individual circumstances, they would be better eliminated from the category of "don'ts" and issued by the supply authority in the form of simple model specifications describing the requirements of good practice suitable for several different classes of wiring work. Such official specifications would in the writer's opinion do much to render practice and prices more uniform, and allow contractors to cultivate different classes of wiring work in accordance with their inclinations and capacity.

In any case, in view of the rapidity with which electrical practice changes and the fact that so much of our work is secured in competition with other systems of light and energy supply, it is undesirable that wiring regulations, however simple, should be administered in an inflexible manner, or pass under the control of any centralized body not directly interested in the commercial

1. Abstract of a paper presented before the meeting of the Incorporated Municipal Electrical Association, at Brighton, England, June 27 to 30.
2. Chief electrical engineer, Tunbridge Wells, England.

development of the supply undertakings involved.

A brief analysis of the published regulations of a number of British and foreign authorities controlling or advising upon electrical work shows how great a divergence exists in their requirements, and suggests that, even after allowing for climatic differences and local conditions, the cost of wiring must be affected considerably by the varying limits imposed.

The usual insulation-resistance test depends more upon dryness of the building and care used in connecting up fittings than upon the actual resistance of the dielectric, and a fair result may be obtained from wiring which has suffered considerably by careless workmanship and may be doomed to early failure. For these reasons, a much lower insulation resistance than is usually called for would suffice, but should be supplemented by inspection of samples of hidden work in every case.

With respect to the limits of lighting capacity which may be connected to one side of a three-wire system, it would appear that the true limit lies in the ability to make proper current-carrying connections in the various "loop in" fittings used on branch lighting circuits; ten amperes should be a workable maximum.

Respecting the limit of motor capacity which may be connected to one side of a three-wire system, these limits should depend upon the capacity of the system; in some cases most stringent regulations are issued by very large undertakings.

Provided that wiring is not dangerously overloaded, the question of pressure drop concerns the consumer chiefly, and the increasing efficiency of lamps does not warrant heavy wiring.

The most striking difference between British and German wiring regulations lies in the permissible loading of cables.

Amongst several provisions which now seem curiously out of date are the following:

Motors to be insulated.
No installation to have less than two branch circuits.
No copper fuses to be used.
Single-pole switches to be used on each main.
Meter shunt wire to be taken to lamp side of consumer's main switch.
Slip conduit prohibited.
Metal conduit to be avoided if possible.

A few, however, are conspicuously in advance of the period when they were written—for example:

Bath-room lights to be out of reach of persons in water.
Tubes and frames to be continuous and well earthed to water pipes.
No elbows to be used in conduit.
The use of key socket holders to be restricted.
Internal lighting fittings to be insulated.
Meter main coil and all single-pole switches to be on live side of supply.

The rules respecting grounding mostly fail to define the essential requirements for security from risk of shock or fire, which are that every part of a metallic sheathing or conduit system containing conductors shall be permanently connected to earth by a conducting path of sufficiently low resistance to carry, without sparking or heating at any part of system, the maximum current which the main fuses of the installation will pass.

Tests made with lamp or bell for the continuity of a tube system give little indication of the current-carrying capacity of the many joints and connections through which a fault current would have to be discharged, whilst the accidental grounding of the tube at one or more points, by contact with structural metal work or water pipes, may make such a test quite deceptive.

Where the system of wiring makes it impossible to render all metal work of motors, lamps, and other apparatus metallically continuous, it is advisable to run throughout the installation a substantial and visible ground wire or tape, to which all apparatus can be connected, and to connect it to ground at one point. This connection can be tested at intervals from different points of the installation by taking an ammeter reading between it and the live poles of the wiring through a small known resistance. The readings will show up any change in the state of the ground connection and prove its energy-discharging capacity in a way which tests with a bell or lamp do not do.

Where these methods of grounding are not possible, it is necessary to resort to devices of the lightning-arrester type. In these a small air gap is maintained between the outer, neutral, or earthed pole of the system, and a connection which includes all tubing, frames, and metal work; in the event of the latter rising in potential beyond a certain limit the air gap is bridged by a spark or by electrostatic attraction of a light metal armature, and a short circuit results, opening the fuses or circuit-breakers. The devices have the drawback that they will not operate with certainty excepting for pressure rises of considerable amount and so do not altogether avoid risk of shock; they are of a more particular value on high-tension systems where good ground connection cannot be obtained.

In an ordinary house wired with slip-joint tube, a leakage current occurring at any point at all remote from the service entry will probably have to run the gauntlet of sundry loose connections under floors and behind lath partitions on its way to earth.

Undoubtedly these considerations present one of the gravest objections to the simpler systems of metallic conduit. Some device is needed to protect concealed wiring mechanically without involving the danger of spreading a leak, or the difficulty of furnishing a completely grounded sheath.

Steel tube has much to recommend it on the score of protection for wires and low cost of erection, and has done much to encourage the wiring of small houses during construction for which purpose it is very suitable.

It would seem worth while to consider the extension of grounding only portions of tube within usual reach in wet places, and keeping the remainder in isolated single lengths by the use of fittings and sockets which actually insulate instead of partially connecting as at present; this could be effected by lined sockets or by serving the outside of the tube with compounded tape or braiding (a similar process is used for the protection of iron gas and water mains on the Continent), and would not increase the cost of the conduit appreciably, whilst protecting it from rust and destruction by ash concrete and plaster.

The principal weakness of the grounding precaution lies in the fact that it is not essential to the working of the installation, and the wires and joints upon which it depends may suffer damage without the fact being revealed until they fail to give the expected protection.

Conduit.—Condensation trouble is only serious where runs of conduit are subject to different temperatures, as in passing from living rooms to cellars and outdoor positions and can, to a great extent, be prevented by providing drain holes at lowest points and by the use of inspection boxes well filled with slag wool or similar non-conducting substances at points between which

considerable temperature difference may exist.

Corrosion in buried conduit is generally the result of condensation which, particularly with "close" joint tubes, permits surrounding plaster to become moist and chemically active. This is very noticeable with plaster or concrete made from ashes. The use of "close" joint tube in any form of cement or plaster is undesirable but difficult to prevent on jobs where brazed or seamless material is not insisted on throughout.

There appears to be a useful field for a conduit lapped with coarse tape or jute and compounded outside for such positions.

The first test of a good class slip conduit lies in the interchangeability of the tubes and fittings and the possibility of making firm metal-to-metal joints at all points after removing the enamel. One of the reasons for using inferior conduit on low-grade work lies in the fact that fittings are an easier fit and more rapid erection is secured, at the expense, of course, of continuity. Various devices have been put upon the market to enable slip tubing to be made continuous without appreciable increase in cost. For the most part, however, they introduce difficulties in use and are always apt to be omitted where tube is fitted in awkward positions, whilst their weakest feature is that they do not render it necessary to remove the enamel from the tube and sockets and are therefore inferior to accurately made plain connections which cannot be socketed home until the metal is cleaned and some force employed. In some instances slip tubing has been put together with wet salamoniac in order to secure a rust joint, an injurious practice, owing to the corrosive and hygroscopic nature of the salt.

There seems to be no reason, however, why a useful amalgam-like jointing mixture should not be made, similar in composition to aluminum paint or the paste solders.

Safety.—One of the greatest safeguards for the consumer lies in the use of correctly proportioned fuses, and, where possible, the cartridge form or the modern development of the old Edison screw plug fuse should be used, but the cheapness and convenience of the ordinary porcelain bridge fuse will prevent it from being easily superseded; it is therefore desirable that consumers should be provided with simple information with regard to fusing. As it is not possible to prevent untrained persons from replacing blown fuses, the next best thing is to furnish easily understood instructions for doing so.

CHEAPER WIRING METHODS.

Concentric Systems.—The most important recent development in wiring appears to be the re-introduction of the concentric principle in the form of the "Stannos" wiring system.

This material is now well known, and where it is possible to work on the surface of a building and use concentric conductors with the outer or return sheath grounded, a saving in cost of ten to fifteen per cent over slip-joint conduit wiring can be secured by means of it in the hands of men accustomed to its use.

Its chief disadvantages appear to be:

The multiplication of mechanical joints or points where loose connections may occur.

The difficulty of securing to plaster and composition walls and ceilings.

Comparatively feeble resistance to accidental damage.

Risk of loss of continuity and consequent sparking or pressure rise on the outer conductor in the event of loose contacts or breakage of sheathing.

These difficulties are rather matters of detail and many of them can possibly be overcome. As the superior economy of this system over conduit is only apparent when the wire is used concentrically, it has so far been most successful on alternating systems where the use of a transformer affords a ready means of isolating the consumer's wiring from the supply network; as such transformers may also be used to reduce voltage, their cost is not altogether chargeable to the concentric wiring. Where, however, it is required to use double Stannos wiring, the outer sheaths acting merely as a mechanical protection, no trouble arises from inductive drop with ordinary sizes and currents—experiment has shown that up to twenty-five amperes the drop at ordinary periodicities is quite inappreciable in a fifty-five yard run.

The great value of this material lies in the fact that faults quickly develop into short circuits and put the bad section out of use whilst repairs are easily carried out; in addition, all the simplicity and advantages of a single-pole system are secured.

Flexible wiring has been much discussed from time to time but no effort made to define its utility or to establish any regulations which might make it safe for certain classes of work without rendering it too expensive; in consequence a considerable amount of such wiring is actually in use in this country, the material being used in a most improper manner and only saved from failure by its high quality. Some attempts have been made to produce a strong and safe flexible wire, the result being usually rather clumsy and as costly as the cheaper forms of permanent wiring. There would appear, however, to be a field for such material in connection with heating circuits. A heavy armored and fairly flexible cord to carry up to ten amperes without overheating, and provided with good plug terminal fittings and fuses of the cartridge type, might reduce the first cost and consequent difficulty of inducing users of electric light to put in heating and cooking apparatus; such wiring could also be a tenant's fixture capable of removal to, and use in, other premises.

A disadvantage peculiar to all fixed-surface wiring systems lies in the difficulty which is met with when redecorating walls and ceilings, particularly when papering—this fault is sometimes lost sight of by those who advocate such systems on the grounds that existing decorations will not be injured.

Relative Cost per Light of Wiring in Small Private Houses Complete with Metallic Lamps and Simple Pendants.

	Percentage of No. 1		
Screwed seamless conduit (steel) and 600-meg class non-association cable	123	Conduit Cable Fittings Labor Per light	$1.40 1.40 1.40 1.28 $5.48
Brazed slip conduit with clamp continuity fittings	116	Conduit Cable Fittings Labor Per light	$1.34 1.40 1.40 1.03 $5.17
Brazed slip conduit and 600 meg class non-association cable	107	Conduit Cable Fittings Labor Per light	$0.97 1.40 1.40 0.97 $4.74
Brass-cased paper tube	104	Tube Cable Fittings Labor Per light	$0.85 1.40 1.40 0.97 $4.62
No. 1. Close joint slip conduit (steel) and 600-meg class non-association cable	100	Conduit Cable Fittings Labor Per light	$0.67 1.40 1.40 0.97 $4.44
Wood casing and 600-meg class non-association cable	96	Casing Cable Fittings Labor Per light	$0.30 1.40 1.40 1.16 $4.26
Stannos wiring (concentric)	71	Cable Fittings Labor Per light	$1.52 1.40 0.30 $3.22
Twin rubber and lead-covered cable	71	Cable Fittings Labor Per light	$1.52 1.40 0.30 $3.22
Rubber and cotton flexible and button insulators	70	Cable Fittings Labor Per light	$1.40 1.40 0.30 $3.10
600-meg class non-association cable and cleat insulators	57.5	Cable and insulators Fittings Labor Per light	$0.85 1.40 0.30 $2.55

COST OF WIRING SMALL PREMISES.

The influence of the system adopted upon cost is indicated by the preceding figures, which, although actually variable according to circumstances, are relatively representative of the principal methods available for wiring small houses.

Examination of these figures also brings out the fact that on the cheaper systems labor costs become a much smaller proportion of the total, suggesting that it is only under some organized scheme of wiring houses in quantity such as might be arranged by a supply authority (or central-station company) that the fullest economy of these methods can be realized.

In putting in very small installations by means of workmen not continuously employed on this class of wiring, it is not to be expected that the labor costs can be kept down to the figure necessary to justify the methods.

Although this paper was prepared before the publication of the 1911 edition of the rules of the Institution of Electrical Engineers, the writer was able by the courtesy of the Institution to inspect a copy, and would draw attention to the principal changes in so far as they affect small installation work.

The alterations of most general interest are contained in the table of carrying capacity of cables—the new values having been determined by experiment under working conditions and set out in relation to length of conductor and unit pressure drop:—

Cable.	Maximum Amperes. Old Limits.	New Limits.	Percentage of Increase.
1/18	4.2	7.2	71.5
3/22	4.2	7.8	85.5
3/20	6.4	12.0	87.5
7/20	13.0	24.0	84.5

Although these new limits are only about sixty per cent of the values allowed by the Verein Deutscher Electrotechniker they represent a great practical advance and should reduce wiring costs whilst allowing a good factor of safety against increase in loading which might take place after an installation has been put into service.

In conclusion the writer would express the hope that discussion of some of the points raised in this paper may assist in stardardizing the practice of wiring in small premises and help to evolve specifications which will enable builders and property owners to put in electric light wiring with the same confidence that they now have in ordering the standard work of the plumber and gasfitter.

Slow Alteration and Spontaneous Combustion of Coal Exposed to Air.

A summary of a paper by M. Lécrivain is given in the *Electrical Review*, London, from which the following statements are taken.

It has been suggested in the past that only pyritic coals, or those coming from "fiery" mines, are subject to alteration on exposure to air. Actually, however, all coals suffer a very characteristic oxidation in air, the ultimate result being spontaneous combustion, attended by more or less serious damage and loss. A detailed examination of the sequence of atmospheric influences on coal is, therefore, of great practical importance.

The process of slow alteration which first occurs is divisible into several clearly defined stages:

(a) The physical state of the coal is altered. Surface oxidation causes minute fissures which rapidly extend right through the lumps, thus the size of the sound pieces continually decreases.

(b) A change of weight occurs in three stages: (1) loss by escape of moisture and occluded methane; (2) gain by surface oxidation; (3) loss by escape of hydrocarbons formed by the partial decomposition of the coal. Stages (1) and (2) occupy more or less time, according to the exact state and nature of the coal, but spontaneous combustion rapidly follows stage (3).

(c) A loss of calorific power and a deterioration of lighting and coking values follow the escape of gases from the coal. If the carbon content of the latter be low and the atmospheric temperature high, this loss of gas is very rapid and may easily exceed thirty per cent in one month's exposure.

(d) The available by-products are diminished, and the quality of the coke deteriorates. The quantity of ammonia salts recoverable may decrease by fifty per cent during three or four months and M. Fayol finds that Commentry coal gives a good metallurgical coke when freshly mined, but will no longer do so if exposed to the air for six months or so.

Spontaneous combustion is mainly due to the combined action of atmospheric moisture and oxygen. Moisture favors cleavage of the coal, and thus facilitates its oxidation; the resultant emission of heat and elevation of temperature then become progressively more rapid. Beds of coal-dust naturally heat more rapidly than stacks of lumps; stacks thirteen feet or more in height are especially liable to ignite spontaneously, and the oilier the coal and the greater the percentage of smalls, the greater the risk. Foreign matter, other than pyrites, has little influence on the fire risk.

Coal stacked in the open air is bound to deteriorate, but the fire risk may be made low by building only low banks. Storage under water is the best and safest procedure, and the first industrial application of this method is to be found in the 10,000-ton "drowned" magazine, built by the Western Electric Company at Chicago, in 1902.

The causes of subterranean fires in coal mines are not yet thoroughly understood. The best means of fighting such conflagrations is to seal the mine, thus preventing access of oxygen, meanwhile cooling the gases and the incandescent masses of fuel by water jets.

Novel Method of Overhead Distribution.

A novel method of overhead electrical distribution is in use in a Welsh town to obviate the necessity of running pole lines through the streets. The wires are carried on brackets attached to the sides or fronts of the houses about sixty feet apart. The conductors are supported on top-groove insulators and ample room is allowed for access to the roof. The brackets are constructed of 2.5-by-2.5-inch angle-steel about six feet long, though in places a greater length is required. A ground wire is carried above the conductors. No difficulty has been experienced in obtaining the necessary consent of the occupants for attaching brackets to the houses. Objection was at first made to the brackets on the ground that the wires were a source of danger to workmen repairing the roof, but this has not been found to produce any difficulty. A rubber sheet has been provided for the use of such workmen, but it is seldom used. The method has been used principally in industrial districts occupied by small houses, where the load is not sufficient to justify underground mains. This equipment is described and illustrated in the *Electrical Review*, London, May 19, 1911.

The House of Representatives of Connecticut has adopted the report of the Judiciary Committee recommending a public-service commission.

ELECTRICAL Advertising *and* Selling

New-Business Methods of the New York Edison Company.

Although the fact that the New York Edison Company is situated in the largest city in the United States has a great deal to do with its success as a profitable business institution, a large share of the business added to the lines of the company can be traced directly and indirectly to the untiring and commendable efforts of the commercial department in arranging timely campaigns, demonstrations, advertising, etc. And it is safe to say that without this work much of the new business which the company enjoys would be impossible to secure.

It is obvious, therefore, that no central-station company is too large to pay the closest attention to the commercial or new-business department, whether faced with competition or not, nor are the methods pursued by the larger companies in stimulating the interest in electricity and securing new business, financially out of the reach of the smallest central station.

It would be an endless task to chronicle the methods of the new-business department of the New York Edison Company. There are, however, a number of valuable suggestions contained in some of the recently distributed literature of the company which may prove of interest.

One feature of the methods above mentioned, and one which is probably unique in central-station new business, is the scheme adopted for the letter heads used in the new-business department. Each sub-department has separate stationery, each being suggestive of the business transacted by that department. Take, for instance, the sign department. When writing to prospective customers in the drug business, or shoe business, letter heads having two photographs of typical drug or shoe signs are used—both a day and night view being reproduced. The cuts are of moderate size and are placed in the upper left and right-hand corners with the company's name and address between. The printing, art work and stationery are of the highest character, which is very essential in making a favorable impression on the "prospect."

This scheme is followed out with other classes of sign customers, such as lunch rooms, cigar stores, pool rooms, florists, etc. Also the automobile department, residence lighting department, commercial lighting department, fan-motor department, heating department, industrial department, etc., use stationery with photographs showing typical installations. In following up prospects with letters the company also makes an effort to use stationery of a different tint and general design so as to obviate that "sameness" apparent in so much advertising correspondence. Whatever else may be said of this plan, it most assuredly lends an individuality to the correspondence which is sure to make a favorable impression upon the recipient.

The "electric apartment" conducted by the New York company a short time ago has done much to stimulate the sale of household devices. This model up-to-date apartment was epuipped with the different electrical devices which were seen in operation in each room. The dining room contained electric chafing dishes, coffee percolators, toasters, and electrically lighted table decorations, while in the kitchen were seen the latest type of electric range with all appurtenances; the bedroom had an electric curling iron, heating pad and heater for nursing bottle. In the parlor was found an assortment of beautiful electric portable lamps. An electric radiator suitable for such an apartment was also shown in this room. In the bathroom was an electric radiator, shaving mug, etc. The whole apartment was artistically lighted by electricity. All heating and lighting devices were demonstrated in actual use each afternoon. An illustrated description of this demonstration was given in the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN for May 13, 1911.

Cooking by electricity was shown to be entirely feasible, convenient, economical and attractive to ladies giving luncheons, receptions, etc. Subsequently the Edison company issued an attractive book containing recipes for cooking by electricity. Each page contains a separate recipe with a view of the electrical device necessary to prepare it in the border. These tempting recipes will create a desire on the part of the ladies to try them and if not already supplied with the necessary cooking appliances, increased sales should result.

In the course of an electric-vehicle campaign the New York Edison Company prepared and distributed a convenient booklet giving the names and locations of the various charging stations in the vicinity of New York, together with a map showing the automobile routes to suburban points and the relative location of charging stations.

Another publication worthy of more than passing interest is a booklet, entitled "Edison Service and the Telephone," which, as its name implies, deals with the transacting of company business by means of the telephone. It is a book of instructions and suggestions for the company employees. As the telephone traffic of the company averages 16,000 calls daily, the need of such a book is obvious. The entire text of this publication is worthy of reproduction, but the concluding paragraph can only be reproduced here as indicating the general policy of the company:

"Remember that that which is the correct thing to do in a face-to-face conversation is also correct in a telephone conversation. The fact that a line of wire and two shining instruments separate you from the person with whom you are speaking takes none of the sting out of unkind words.

"Be forbearing, considerate and courteous. Do over the telephone as you would do face to face."

It is claimed by some central stations that a great deal of trouble is encountered in transacting business over the telephone and it is generally conceded by the public that no satisfaction can be gained over the telephone when deal-

ing with a large corporation. This little book, then, serves a double purpose—insuring the public courtesy and satisfaction over the telephone and lessening the difficulties of the company.

These are simply a few of some of the more recent methods adopted by the new-business department of the New York Edison Company. Attractive and timely circulars, post cards and folders are being continually distributed, followed up by consistent newspaper and billboard advertising, personal solicitation and courteous treatment to its present customers.

The Heating of Small Motors.

In the July issue of *Chained Lighting*, the monthly organ of the Louisville Lighting Company, Louisville, Ky., there appears the following timely advice to customers, regarding the heating of small motors—particularly fan motors.

The advent of warm weather always brings a number of complaints in regard to heating of small motors. These complaints are usually from dealers or users who are possessed with the idea that if the motor-body does not feel nice and cool to the hand, the windings are in imminent danger of burning out.

An analysis of the facts in regard to temperature rise invariably shows that in practically no cases complained of is there the least danger of injury to the motor.

The standard of the American Institute of Electrical Engineers permits a temperature rise of forty degrees centigrade, the equivalent of seventy-two degrees Fahrenheit. As a matter of fact, the temperature rise of a majority of the types of small motors and fan motors will not exceed 20 to 30 degrees Fahrenheit under continuous operation, and will rarely or never equal half the temperature rise allowable under the standard above mentioned.

However, let us say, for instance, that a small motor has a temperature rise of thirty degrees Fahrenheit when operated continuously. Such a motor operating on a day when the normal air temperature is seventy degrees, would reach a temperature of only 100 degrees, which would feel only comfortably warm to the hand.

The same motor operating on a midsummer day when the thermometer runs from 90 to 95 or 98 degrees will attain a temperature between 120 and 130 degrees Fahrenheit. Any temperature over 120 degrees is quite uncomfortable to the touch, and gives rise to alarm on the part of the inexperienced motor user.

However, a motor with a surface temperature of 125 degrees is in no danger of injury from overheating, and motor users who make complaint of the heating effect under such conditions should be advised to continue operating their motors until it is apparent that the windings are being damaged. Unless there is some odor of burning insulation, the motor cannot be considered in danger.

Users are perfectly familiar with the well known heating effect of the common incandescent lamp, and only the very inexperienced think of inclosing the lamp in inflammable material or of trying to hold the hand on a burning lamp. There is about as much use for holding the palm of the hand on a lamp as there is for holding it on the motor.

Another School for Central-Station Employees.

The value of a central station educating its employees along definite lines is again attested to by the announcement that the San Joaquin Light & Power Company. Fresno, Cal., has established a school of instruction for its employees. The school was called to order for the first time by Assistant Manager E. B. Walthall, who, in his capacity as teacher, addressed those present at considerable length as to the manner in which the company fixes its rates.

The plan to establish the school of instruction was originally suggested through a letter sent out by Emory Wishon, manager of the company's affairs at Bakersfield, Cal. In this letter the writer sought to instruct his employees in the plainest language possible as to the reasons that certain rates are charged some business concerns while others are compelled to pay different prices.

The idea of the company is to hold a school of instruction each week, and to have a different topic of discussion on each occasion. At the next meeting the "students" are to be given a thorough course on the intricate workings of a meter.

Though the school for the present will be composed only of the company's local employees, the idea of the company management is to eventually arrange matters so that its employees in other cities will either be called upon to attend the meetings in Fresno at specified periods, or else to have one of the officials go to each city periodically to impart whatever instructions it may be considered essential that the employees should have.

Manager A. G. Wishon in discussing his new school stated that it is his desire that every employee of the San Joaquin Light & Power Company shall have not only a thorough knowledge of the technicalities of his work, but of the business side as well.

Electric Sign for Antigo Electric Company.

Just as the first step in an electric-vehicle campaign is the operation of electrics by the central-station company, so is the first step in a sign campaign the installation of an electric sign advertising the central station. That this theory is approved by the Antigo Electric Company, Antigo, Wis., is evident by its action in installing over its power house what is considered the largest electric sign in the State outside of Milwaukee.

The sign will be forty feet long and twenty feet high. The letters are three feet six inches in height and of the trough type. They will be painted on the inside with white enamel. Over 580 four-candlepower tungsten lamps will be used to illuminate the sign. The words "Antigo Electric Co." will appear at the top of the sign and burn continuously. Below them will be the words "Light" and "Power," which will be flashed on letter by letter. A zig-zag pattern on the sign to simulate lightning will be flashed out at intervals.

Selling Electrically Heated Appliances by Mail.

The Electric Shop of the Commonwealth Edison Company, Chicago, Ill., has issued a catalog which has been mailed to customers of central stations throughout the United States. In following out the catalog idea, the Company first wrote to each central station, stating the scheme for selling direct, and requesting the names of fifteen of the best customers of the central-station company.

Catalogs were then mailed to each of the names included in this well selected list. This is simply a broadening out of this famous electric shop.

Free Fan Service for Invalids.

The DeKalb-Sycamore Electric Company, DeKalb, Ill., and H. M. Byllesby & Company, Chicago, controlling numerous public-utility properties in the South and Southwest, have announced simultaneously that during the summer months free fan service will be extended to any sick person, upon the recommendation of the attending physician. In case the house is not wired service wires will be run and sufficient interior wiring to operate the fans, loaning the latter as long as many be required.

The following is the text of a letter, prepared by A. S. Huey, vice-president of H. M. Byllesby & Company, to be sent to all physicians in the cities served by Byllesby properties: Dr. ————: Dear Sir: I beg to inform you that during the remainder of the summer we wish to place, without charge, electric-fan service at the disposal of every sick person who (or whose family) is unable to pay for the fan and service, and whose sickroom can be reached from our present distributing lines. We ask only that you certify in writing to the desirability of fan service from a medical standpoint and to the financial inability of the patient to secure the same; also that you notify us when the necessity of the service has ceased. If the house is not wired we will run service wires and install sufficient interior wiring to operate the fans, loaning the latter as long as may be required in your judgment. Assuring you of our desire to co-operate with you, etc.

Renting Electric Cooking Appliances.

An article in a recent number of a leading English electrical publication under the head of "Wanted: Electrical cooking apparatus on hire," suggests that money awaits the enterprising man who is first to inaugurate a regular business in the way of hiring out first-class cooking apparatus on reasonable terms, for "in any town worthy of the name" there is to-day a big demand for good electrical cooking ranges, and for some form of electrical water heater capable of giving a continuous supply of hot water throughout the day. Consumers are frequently inquiring after electrical water heaters and cookers. The idea of a nice, clean, neat range with hot water always available and the whole easily operated by means of one or two small switches appeals to many.

The article asserts that people want to use electricity for cooking and domestic purposes, but that the present high price of the utensils themselves prevents electricity from being more extensively used for such purposes. With that great outlay of the first cost eliminated, three parts of the difficulty in the way of electricity for domestic purposes is at once removed. The article says that while there are good stoves and heaters on the market, really serviceable goods, economical in their consumption of current are few and far between, and that charges for power are in the way at present, but the demand would considerably reduce them.

The practice of renting gas cooking ranges is quite common in Birmingham. This city, which owns and operates its gas works, makes a specialty of renting gas ranges, and this rental applies toward the purchase of the ranges if the customer so desires.

The electric department of the city has also recently held an interesting exhibition of electric cooking apparatus. It engages in the installation and hire of electric motors and dynamos. If electric cooking apparatus could be provided on reasonable terms, there would seem to be little doubt that the electrical supply department of the city would be glad to rent them. The city now makes a special rate for electricity for heating purposes as distinct from the current supplied for lighting. With a greater demand for electricity during the daytime it is quite likely that the rates would be proportionately reduced.

Central-Station Advertising.

At the recent exposition held in Bloomington, Ill., for the purpose of advertising home products, the Bloomington & Normal Railway Company maintained an interesting exhibit in which it displayed various household appliances which could be operated with "Made in Bloomington" electricity.

During a spectacular night parade, which took place during the show, the company played a powerful searchlight, installed on Bloomington's tallest building, intermittently on the line of march and one of its advertising signs in view of all spectators.

Electrical Decorations.

Electrical effects played a conspicuous part in the official inauguration of the Toronto (Can.) Hydroelectric System on May 2. The principal decoration was a miniature imitation of Niagara Falls, the source of the city's electric supply—ninety miles away. The banks of the river were represented by painted scenery; the falls were represented by real water illuminated by white and green beams from searchlights placed on nearby buildings. High above the falls the word, "Inauguration," appeared in large electric letters, and below the falls were large electric torches and other electrical effects.

Converting "Sweat Shops."

The Edison Electric Illuminating Company, of Brooklyn, has recently prepared for distribution among the class of clothing manufacturers usually termed "sweat shops" a circular printed in Hebrew calling attention to the advantages of motor drive and electric light.

The circular gives the names of a number of those manufacturers who have already taken advantage of the cheaper and more sanitary methods of operating their machines. Excellent results have already been reported.

Signs to Warn Drivers.

The Board of Public Works of Indianapolis has devised a system of electric signs to be placed in front of all hospitals, warning drivers and others to drive slowly and with as little noise as possible.

This is an innovation and shows another avenue for the use and sale of electric signs.

The Federal Light & Traction Company, the new owners of the Springfield (Mo.) Gas & Electric Company, is engaged in a campaign to increase the number of electric signs in that city. W. W. Farris and W. J. Gunter of the Company are now in Springfield, showing the merchants the advantages of electric signs.

An attractive, illustrated folder, recently distributed by the Philadelphia Electric Company in the course of an electric-fan campaign has been instrumental in influencing new business.

ELECTRIC LIGHTING and ILLUMINATING ENGINEERING

LIGHTING A FACTORY.

BY E. R. TREVERTON.

It is the object of this article to describe the manner in which a very dark machine shop was lighted by a very simple but effective method, and one that has given entire satisfaction to all concerned.

The location in question is a typical inside factory one, being an aisle forty feet wide situated between two other aisles of a slightly greater width, and separated from them only by the columns that carry the roof; 400 feet of this aisle is used for general machine work, mostly lathe work. The ceiling is formed by the floor above, and is divided into bays 40 by 16 feet by the supporting girders. A crane runs the entire length of the aisle with a clearance of only thirteen inches above the hoist.

The natural lighting comes from the aisles on each side, one having a row of windows occupying the entire outside wall, the other making use of skylights and a row of windows just under the roof. The light from the first source was mostly cut off by a row of high machines directly in front of the windows and by the intervening columns, crane girders and the like. From the other side, the windows being so high in comparison with the width of the room, only a narrow strip of floor was directly lighted, and this only imperfectly on account of the machines located just along the edge of the aisle. It was necessary to use artificial light at all times, as under the best conditions of a bright day the natural light was very dim.

Formerly, clusters of carbon lamps scattered here and there formed the general lighting scheme, each machine being furnished with one or more extension lamps, which were moved from place to place as the operator required. Not only was the light insufficient, but the constant transfer of lamps with the consequent breakage and damage to the cord made the maintenance cost so high and reduced the efficiency of the workmen, both in quality and quantity, to such an extent that some change was made necessary. It was impossible to keep good men on account of the inconvenience and unpleasantness of the location.

The small clearance over the crane, together with the low ceiling, excluded all types of lamps except the incandescent. Tungsten units were selected as being the most applicable. The bays were each equipped with eight 100-watt, clear tungsten lamps, with intensive glass reflectors, mounted directly on the ceiling, with one inch of free cord between the rosette and the socket. The lamps were in two rows of four lamps each per bay, thus making the spacing distance 8 by 10 feet, with a power consumption of 1.25 watts per square foot of floor space. The switching was arranged so that four lamps could be operated in a group, thus permitting small areas to be lighted without waste. With the use of Westinghouse wire-type lamps the breakage has disappeared, regardless of the vibration due to cranes and to the dropping of heavy weights on the floor above.

The illumination was uniform and of sufficient intensity for the class of work done there, and the place was transformed from a gloomy into a cheerful location. The spirit of the men improved, as was shown by the quality of the work turned out. There were numerous other advantages.

TUNGSTEN LIGHTING IN A FACTORY.

This system has been in service for well over a year and careful records have shown that the cost is reasonable and that the saving in quality of work and the ability to keep good men has more than repaid the original expense.

The accompanying photograph, taken at night without any light except from the ordinary source, shows the location and gives some idea of the satisfactory character of the illumination. All parts of the room are sufficiently lighted to permit of work being done with equal ease at any point. Tests showed that the average intensity of the horizontal plane averaged 2.5 foot-candles, with a minimum of 1.6 foot-candles at the extreme edge of the room.

Importance of Good Light in Factories.

At the sixteenth annual meeting of the National Association of Manufacturers, held at the Waldorf-Astoria Hotel, New York City, on May 15, 16, and 17, a very interesting report was submitted by the Committee on Ventilation, Heating and Lighting. About 800 manufacturers were present when this report was read. The committee was composed of William Coale, chairman, W. H. Kann, and W. G. Kerckhoff; Mr. Coale is well known as the treasurer of the Sterling Electrical Manufacturing Company, Warren, Ohio.

The report of the Committee is well worth reading in detail. It consists largely of a summary of some 250 answers to a series of questions that had been sent to the members of the Association. These answers make it very clear that some employers are much more alert than others in recognizing the relation to factory production of such factors as quality and circulation of air, humidity, heating and lighting. Following are some of the Committee's more important comments respecting factory lighting.

As was expected, the answers to the questions respecting light have not furnished any statistical information of value, but they have brought out a great deal of interesting information. In the main they make clear that the question of good artificial light is one that has not been given very careful consideration by manufacturers in the past, although a number of manufacturers show by their replies that they are now keenly alive to the importance of the subject and feel that it should be given more consideration than has heretofore been the case. A few examples of such replies are as follows:

A shoe factory reports that painting its walls and ceilings white and keeping them in good condition results in better work being done and keeps the employees better satisfied.

A jewelry manufacturer states that the work demands exceedingly good light.

A manufacturer of caramels states that proper lighting is absolutely necessary to get the best results and a larger production.

One manufacturer reports that he employs a well known illuminating engineer to solve the lighting problem for him, but it is to be noted that there was apparently only one manufacturer who had taken this step.

A silk manufacturer states that it is of great benefit to the work to have well lighted, well ventilated and properly heated shops and that even if this were not necessary on account of the effect on output, he would still have them for the comfort of the employees.

A motor company reports that poor light greatly affects the output.

In investigating the question of artificial lighting in factories, the first information desired is the degree of importance of the subject, which can only be ascertained by obtaining some idea of the effect of varying lighting conditions on the product, and it was information of this kind which it was hoped would be obtained from the answers to the questions.

It is the belief of the Committee that the effect of varying character of artificial light on the quantity and quality of product produced may be and very often is very great and, consequently, affects the cost of production to a very considerable extent; and the Committee feels that it is a matter of ordinary observation to those at all expert in the question of artificial lighting that factory lighting, generally speaking, is very far from what it ought to be. The following statement is a brief summary of the principal defects which are ordinarily to be found.

In very many cases there is insufficient illumination. This condition, however, is rapidly improving as the result of the advent of lamps of various kinds of much higher efficiency than anything that has been available in the past. It is a fact, however, that in a great many cases where the absolute amount of illumination is sufficient, the light is nevertheless exceedingly unsatisfactory for various reasons. If the light falls on the work from the wrong direction, not only is there great liability that awkward shadows of the machinery or of the operative's body will interfere with the work, but in addition if light is reflected from polished portions of the machinery or from the work itself directly into the eyes of the operative, the results will be anything but satisfactory. Failure of light to come in the right direction is often very distressing to the eyesight and also, in addition, since it may cause the operative to work in an unnatural position, it may result in unnecessary bodily fatigue as well. Such unfortunate results are often obtained if an attempt is made to light a workroom with too few sources of light. Under these conditions, although some operatives may receive a very satisfactory light, others are extremely likely to get the light in the wrong direction, with the unsatisfactory results above enumerated.

Another very common defect in factory lighting is the exposure of the eyes of the workers to the direct beams of very brilliant lamps. The use of bare incandescent lamps is amost invariably not only inefficient, but also dangerous. Generally, however, there is no difficulty in avoiding this trouble if proper care is taken.

It is true also that, as the result of using the eyes under improper conditions, troubles of various kinds, such as headache, nausea, etc., are often induced, although commonly ascribed to some other cause, and these troubles not only reduce the efficiency of the operative while working, but lead to absences which might otherwise be avoided.

Still another defect often seen is either too great or too little contrast in the illumination of rooms. The former of these is by far the most common and as an example might be given of work on sewing machines, where individual lamps with opaque reflectors are supplied which brilliantly illuminate the machines, but leave the rest of the room in comparative darkness. This too great contrast is not only a great strain on the eyes, but has as well a psychologically depressing effect on the workers. On the other hand, the brilliantly lighted room in which the illumination of all surfaces is practically equal to that of the working surfaces, is also bad, since the eyes are thereby given no opportunity for rest when raised momentarily from the work.

A great waste of light is often permitted to occur, owing to the failure to keep lamps and equipment clean. The loss of light due to this cause if often as great as fifty per cent. One reply and one only referred to this question and showed that its importance was fully realized. This reply was from a typewriter company, which stated that its incandescent lamps were cleaned and polished at least once a week.

In conclusion, the Committee believes that the subject of artificial illumination is one of great importance and well worth careful investigation.

TELEPHONY—TELEGRAPHY, and WIRELESS.

The British Government Telephone Policy.

A clear outline of the British Government's policy relative to the proposed taking over of practically all the telephone lines in Great Britain and the many intricate problems involved was given in the address of the Postmaster-General to a deputation representing various municipal bodies and associations. As alluded to in the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN, volume 58, page 483, this deputation consisted of some 250 representatives that sought the appointment of a select committee to make an exhaustive study of the telephone-rate question. The full text of the Postmaster-General's reply has just been received and from it the following pertinent extracts are taken.

We of the Post Office, and you here representing the local authorities, have in view a common object—how best the Post Office in its administration of the telephone can serve the community whose interest it exists to promote.

There are, I think, three principles on which our national telephone policy should depend. The first is that efficiency of the telephone service is of prime importance. It is a false policy to pay low fees, if the result of the low fees should be a service which is slow, untrustworthy and troublesome, and both trunk and local services must be maintained at the highest level of speed and accuracy.

Secondly, it is our duty to take whatever measures are in our power to see that the telephone is used as widely as possible. The more people who telephone, the more value the telephone is to each person who has it. Telephony in the United Kingdom at present, in my opinion, is very insufficiently developed; one might almost say that it is little more than in its infancy, and then there has been a great increase in the last ten years. Ten years ago, there were 200,000 telephones. Now there are over 600,000 telephones in use. Still, I am looking forward to an increase two-fold, three-fold or four-fold on those numbers, and that is an object which we should strive to attain.

The third principle which I hold, and with which I am sure you are in agreement, is that in its relations with the Exchequer the telephone service should not be asked to provide a large surplus revenue for the relief of general taxation, but that the rates should be placed at such a level as will enable interest and sinking fund to be paid upon the capital charge, to enable the working expenses to be met, and to enable a moderate profit and no more to accrue to the taxpayer in consequence of the risk that he has run.

On the other hand, the telephone service ought not to expect, and I think telephone subscribers do not expect, that they should be subsidized by the Exchequer. The undertaking should be on a sound financial basis, should be dependent of financial support, and should be conducted on self-supporting business lines.

Those are the principles which will actuate me in any measures which it may be necessary to take after the transfer of the Telephone Company's system to the State.

Your resolutions deal mainly with two great questions—the authority that is to control the telephone service, and the rates that are to be charged to the subscribers. Your first resolution asks for an inquiry with a view to the municipalization of part, or possibly the whole, of the telephone services in the towns. * * * So far as I am aware, there is no demand at the present time, no declared demand, on the part of any municipality to undertake the telephone business. I for my part favor municipal industrial enterprise. I have no objection whatever on any ground on principle to municipal trading within spheres which are carefully chosen for their suitability, but after giving to this question close study now for a year, I have arrived at the conclusion that this is not a field in which municipalities can adventure with advantage. The business of telephony is exceedingly technical, and is continually changing, and it is essential that it should be supervised by highly trained, and consequently highly paid experts, who shall be always watching the course of telephonic invention, always experimenting, always developing on the newest lines; and the ordinary municipality, even great municipalities, are still not in a position to have at their command experts of the caliber which a great government department can secure.

Secondly, as I have indicated to you, and as I think you agree, the business of telephony is at present only in its beginnings. It will need in the years to come a constant supply of fresh capital, and American experience has shown that it is most necessary that capital for telephone purposes should always be available in advance of the immediate demand, that you must have spare plant, that you must never wait until pressure exists and discontent arises. You must always have your plant ready in working order, available when the increased demand comes for its use. That means that capital must always be in hand, ready to be employed before the actual need arises, otherwise there is inconvenience and inefficiency, and the telephone service becomes inconvenient and discredited.

Well, now, a government department is in a much better position when it has once acquired powers from Parliament to raise through the treasury whenever needed the capital that is required—a much better position than the municipalities scattered throughout the country.

Thirdly, there is always an advantage in taking a business on a large scale. If you are dealing with a million or two million telephones, you can place your contracts and organize your system much more efficiently, much more economically, than if you are dealing with a system which has perhaps only 20,000, 30,000 or 40,000 subscribers.

Next, a most important consideration—that of trunk communication—is also in England only in its beginnings, and we look forward to a time when it will be a common occurrence for people to communicate freely by telephone from one town to another. Well, if you have different systems under different management in different towns, the efficiency of your trunk communications must suffer. And, further, if there are defects, if there are faults, it is far more difficult to place the responsibility where it properly belongs, than if you have the whole system in one hand and under one control.

Again, the municipal era is not the natural telephone area. If a corporation has control of the telephones of its town, it should also serve the surrounding suburbs, which may be outside the corporation area. It should also serve the surrounding villages and rural districts, whose economic life depends upon the town in the center, but this would involve difficulties with surrounding authorities, as have actually been felt where municipalities have undertaken the business, difficulties of finance, difficulties of rates, difficulties of way-leaves, and of other kinds.

Again, if it is proposed that the towns, which are, of course, the most remunerative parts of the telephonic system—if it is proposed that the great municipalities should be taken out of the national telephone system, and the Post Office left with only the least remunerative and more scattered areas—areas with more scattered population—than obviously the telephone development in the small towns and in the country districts will be held back. It will be impossible for the Post Office to show the same enterprise in the small towns and in the rural areas, than it would be if it had the whole system under its control, dealt with as one single unit; and although there are many who think that there are drawbacks connected with state management, compared with the management of a private individual or a private company, whatever drawbacks there may be in state management in the lack of private interest and private profit, it would apply to an almost equal extent to municipal management and control.

Those, I think you will agree, are exceeding cogent considerations which must be taken into full account in deciding this great matter of telephone policy. And I would ask you to look back at the experience of the past in this matter. In April, 1899, Parliament passed an act, which authorized municipalities who desired to do so themselves to undertake the telephone service, and it was made known that the Post Office would freely grant licenses to authorities who did so desire. Of the many hundreds of authorities in the country that were in a position to take advantage of that offer, sixty are known to have given close consideration to the subject. Of the sixty, only thirteen applied for licenses, which were granted. Of the thirteen, only six actually started municipal services; and of the six municipal services only two now survive, two having been sold to the Post Office, and two having been sold to the National Telephone Company. With respect to the two now remaining, the corporations of Portsmouth and of Hull, special considerations arose there and I am in communica-

tion with them upon the subject. But in general I take it it is true to say that there is no demand on the part of the great corporations to undertake this difficult, and it may be regarded in some respects speculative, business; while, on the other hand the experience of the past indicates very clearly that it may better be conducted by a central organization than by a local one.

In those circumstances I do not think I should be justified in asking Parliament to appoint a select committee to examine into this aspect of the question, first, because my own view, which is shared by all my predecessors, is that it is inadvisable for the business to be conducted by the municipality; secondly, because there is no demand on the part of the municipalities; and, thirdly, because it is inadvisable to appoint a select committee without strong reason for doing so, in view of the fact that my department, and especially the telephone branch, is heavily burdened this year with the work of preparing for the transfer and organizing the new system; and it would not be fair to put upon them the additional burden of preparing a case and appearing before the select committee, unless there were strong reason for so doing. So far with respect to municipalization.

I now turn to the question of rates. The question of rates does not, of course, arise on the telephone bill which will be introduced this year. That bill is merely in order to enable the department to carry out an agreement which was entered into in the year 1905, which was then sanctioned by Parliament, and which cannot, of course, now be repudiated. I announced lately, through a communication to the press, that there was no intention whatever of altering any of the existing rates on the transfer of the company's business to the state, and indeed it should be obvious to everyone that it is impossible to revise the present rates, or decide what are the proper rates to charge, until we know what is to be the cost of the plant which we are buying. What would be thought of a minister who said to the contrary, "I do not know how much this system is going to cost, but I will fix at once the price which will be charged for the use of it." Elementary principles, not only of sound finance, but of common sense, would prevent us going into the proper rate of charge until we know what is to be the cost of the plant, and consequently what is to be the cost of the sinking fund and the interest payable on the capital which we have to invest. There will, therefore, be no change of any kind until the system has been transferred the first of January, until the court of arbitration has sat and until that court has declared its award. Then the system of charges must indeed be reviewed.

Clearly the rates need review, but I think it would be an annoyance to the community at large, and certainly not approved by public opinion, if I were first to change the rates now at this moment before I knew what the cost of the service was to be, or change the rates on the first of January next, and then a few months later change the rates again after the award had been given, and after we knew what the rates were likely to be for some years. Therefore, I think you will probably agree with me that the right course is for the whole question of rates to be reviewed, not at this moment, but after the arbitration award is complete, and when we know what is likely to be the financial position of the service.

I observed with much pleasure to-day that Mr. Stevenson stated that a measured rate was quite sound in principle if it were not unduly high. But hitherto I have been asked to pledge myself in advance to the principle of a flat rate for unlimited service; that if a man paid so much per annum he should be entitled to use his telephone to its utmost capacity, no matter how many calls he might make in a day or a year. Well, of course, it is a great convenience for individuals to know at the beginning of the year precisely what they will be paying for their telephones, and not to have any additional charges to defray, and it is undoubtedly a great economy for the large user to get his telephone service—as many of the large users are now getting their telephone service—below cost price, for many of these flat rates are unremunerative. But the effect of an unlimited service at a low charge, at below cost price, is simply this, that the large user is being subsidized either by the small user if the telephone system as a whole does not suffer a loss, or else by the taxpayer of the country, if the telephone system as a whole does suffer loss. No one would say that it is a sound principle to supply electric light, or gas, or water, irrespective of the quantity consumed, or irrespective of the size of the building that was supplied. No one would say that it would be a right policy to allow an individual to pay down a lump sum once a year to the Post Office and for that sum to send as many letters or telegrams as he chose. In all these services cost is in relation to use, and the whole weight of telephone expert experience in England and in America, where the telephones have reached their largest development, is against the principle of a flat rate with unlimited service. What the amount of a measured rate should be is, of course, an entirely different question, which I do not now wish to pre-judge

In the circulars that have been sent to local authorities by the Glasgow corporation, it is indicated that the example of Glasgow, which supplied an unlimited service for $5.11 a year, was worthy of emulation, while on the contrary the Post Office was contemplating a sum of between $150 and $200 on the measured rates. Now, both those figures are open to much criticism. I have the highest respect for the corporation of Glasgow. I think they have done wonderful things for their city. I remember visiting it twenty years ago and again quite recently, and the progress which has been made is most remarkable, largely, perhaps mainly, due to the enterprise of that corporation. But in the excursions into the domain of telephony the corporation has not been equally fortunate.

They put by a sinking fund for the replacement of their plant on the basis of a thirty-years' period, which certainly does not err on the side of cautious finance, when one considers the natural life of a telephone plant. Half the operators of Glasgow received wages of $2.19 a week or less; 246 out of 302 received a wage of $2.92 a week or less; yet after five years the undertaking had to be given up on account of financial considerations.

After five years the plant was sold to the Post Office; it was valued by the Post Office at $1,290,000, but was ultimately purchased by the Post Office very much above that, at $1,525,000. Since then the corporation has had to find out of its funds $80,000 to make good the loss it had suffered, and the Post Office has had to spend $500,000 to provide a really adequate plant.

Consequently the experience of Glasgow is not one which the Post Office would desire to follow, with the possibility of the result being the same, and I do not know on what principle the Glasgow Corporation advises the Post Office to adopt its $5.11 rate, unless it is on the principle of the fox in the fable, which having lost its tail in a trap wished the other foxes to get rid of their tails also.

With regard to experience elsewhere, Sweden has been quoted here to-day, but I would remind those who are gathered here that those who have the cheapest telephone rates in Sweden have very restricted facilities indeed; and further that the cost of labor, the cost of land, and the cost of building, are so much lower in Sweden, Norway and Denmark, that no comparison can fairly be made between the rates there and our rates here.

Further, the circular of the Glasgow corporation suggests that 10,000 calls, which is the basis on which they calculated the $150 or $200, is an ordinary use of a telephone. Facts do not bear out that contention. If you take the National Telephone Company's flat-rate subscribers last year, the average calls per line—not per telephone, but per line—were 2,156 in the year, and that is the average rate, and a rate of 10,000 calls would be an extreme rate which is exceedingly seldom reached, and when it is reached is reached only at the expense of blocking the line and causing a great number of ineffective calls because the subscriber's telephone is engaged.

The figure of $150 or $200 is entirely imaginative. There is no prospect of any such rate being charged. The measured rates which are now charged have to be somewhat higher than would otherwise be necessary, Because there are such a large number of large users who are getting their telephones below cost price, and if the matter were equalized, then there is every prospect that the present measured rates which are complained of to-day could be reduced, and that equality would be obtained as between large owners and small.

With respect to an inquiry before an alteration is made in the rates, I would desire to say this. Next year when the arbitration is completed and the cost of the system has been ascertained, it will be the duty of the Post Office to formulate a scheme of rates based upon that ascertained cost, and in accordance with the principles which I enunciated at the beginning of my remarks this evening.

I have no objection whatever to the holding of an inquiry into those proposals. I have no desire or intention to carry out automatically a sudden and far-reaching change of rates without opportunity being offered for representations to be made by the interests affected, for those representations to be impartially investigated.

Chicago Street-Railway Merger.

As recently announced, the elevated railroads in the city of Chicago have been merged into one corporation, and a further merger with the surface lines is contemplated in the future. The Commonwealth Edison Company, which already furnishes some of the motive power for the electric railways, is said to be involved in the consolidation. The underwriting agreement for the elevated merger contains a clause providing that if the surface lines are not consolidated with the Chicago Elevated Railways within three years, the Commonwealth Edison Company agrees to pay to the stock syndicate $6,000,000 less a sum equal to $30 per share of the common shares distributed to depositors of the old stock, and retains the option to purchase from the syndicate all preferred shares, not taken by depositors, at $125 per share. If this option is exercised, the above $6,000,000 is to be deducted from the payment for stock.

The Commonwealth Edison Company proposes to furnish the entire motive power for the elevated lines.

New Electrical and Mechanical Apparatus and Appliances.

SHUNTING VERSUS BRIDGING IN THE SERIES-PARALLEL CONTROL OF RAILWAY MOTORS.

BY CLARENCE RENSHAW.

In the development of apparatus for the series-parallel control of railway motors one of the first problems which presented itself was how to effect the change to parallel after the motors has been brought up to full speed in series with all of the resistance cut out. The obvious method, of course, is to shut off the power, change the connections and then start up again. This arrangement is used in the well known Westinghouse L-4 controller, widely employed in interurban service, as well as on the type M equipments on the lines of the Manhattan Elevated Railroad in New York City, and on many other type-M control equipments in all parts of the country.

With this arrangement, the car, of course, loses some headway while the circuit is open. The inertia of the car itself and of the rotating armatures, however, tends to prevent any great slackening of the speed, and, if the resistance is properly proportioned and the controller handled with reasonable care, very satisfactory results are obtained.

Where very rapid acceleration is employed, the momentary slackening of the car or train in passing from series to parallel can usually be detected by one who is watching for it, although, as a rule, no more readily than can the passage from one resistance notch to the next. On account of its use in the L-4 and other similar controllers, this arrangement is frequently referred to as the type L connection.

The complete shutting-off of power from the car while changing the motors from series to parallel, as is done with the L type connection, is, however, not at all necessary. If two motors are running in series, it will readily be seen that one of them can be completely short-circuited, the proper resistance is simultaneously inserted in the circuit of the second. Not only can the current through the motor which is left in circuit be maintained at its same value, but by suitably proportioning the resistance inserted, it can be regulated to any desired value. After the short-circuit has been placed around the first motor, it may then be disconnected from the circuit of the other motor and finally connected in parallel, instead of in series, with it. In this way, therefore, the change can be made from series to parallel by opening the circuit of only one-half of the motors, instead of all of them, and the load on the other half may be increased sufficiently, during the brief period required for the change, to partially maintain the acceleration of the car.

This arrangement has been very widely used for many years in nearly all of the well known type K controllers, and on this account it is usually referred to as the K type connection, although it is sometimes called shunting.

By referring to Fig. 1, which shows a schematic diagram for a typical Westinghouse type HL control equipment, the details of the K type arrangement may be more readily understood. With the controller on the fifth notch, which is the full-series position, the current comes from the trolley through switches LS, RI and R3, then divides through Nos. 1 and 3 motors, next goes through switch S, and finally divides through Nos. 2 and 4 motors to ground.

When the controller handle is moved towards the sixth notch, switch R1 first drops out. Current then enters through switch R2, part of it going to the motors through one section of the resistance and the remainder through the other section and through switch R3, after which its path is as before. The result, therefore, has been to insert resistance in the circuit.

As the handle is moved further, switch G next closes. This allows the current to go direct to the ground, after dividing through Nos. 1 and 3 motors, without passing through Nos. 2 and 4; that is, this short-circuits Nos. 2 and 4 motors.

As the handle is moved still further, switch S then opens, cutting off Nos. 2 and 4 motors from the series connection

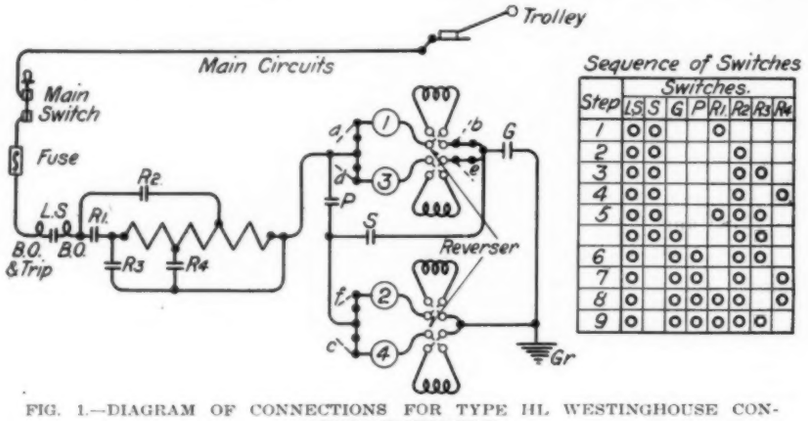


FIG. 1.—DIAGRAM OF CONNECTIONS FOR TYPE HL WESTINGHOUSE CONTROL EQUIPMENT.

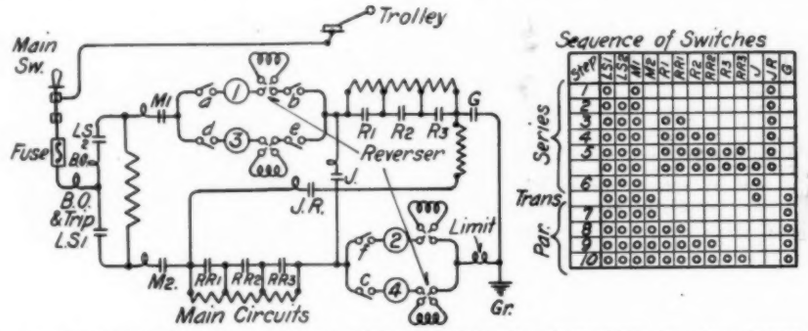


FIG. 2.—ARRANGEMENT OF CIRCUITS FOR MAINTAINING CURRENT IN ALL MOTORS WHEN CHANGING FROM SERIES TO PARALLEL.

and switch P closes, connecting them in parallel with Nos. 1 and 3. The change to parallel is then complete. It will thus be seen that this sequence of changes (which, although requiring many words to describe, takes place in a small fraction of a second) maintains a current, whose value depends on the design of the resistance, through Nos. 1 and 3 motors during the entire time and thus maintains the speed of the car, instead of allowing it to fall off, as with the L type connection.

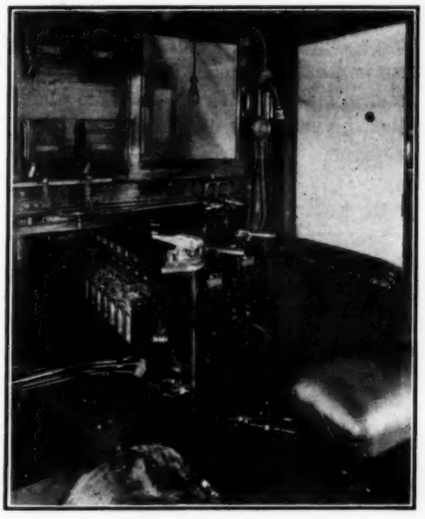
The shutting-off of power from even one-half of the motors while changing from series to parallel, can be avoided and current maintained in all of them, if desired, by the use of the somewhat more complicated arrangement of circuits shown in Fig. 2. With this arrangement, in the series position, current flows from the trolley through switches LS2 and M1, divides through Nos. 1 and 3 motors, passes through switch J, and then divides through Nos. 2 and 4 motors to ground. In changing to parallel, switches M2 and G are first closed, giving a second path for current from the trolley through the switches LS1 and M2 through the first set of resistance, through switch J in opposite direction to the motor current, through the second set of resistance and finally through switch G to ground. Switch J is then opened, leaving the motors connected in parallel instead of in series, and with the first set of resistance in circuit with Nos. 2 and 4, and the second set in circuit with Nos. 1 and 3. It will thus be seen that the change has been made without interrupting the current to any of the motors.

This arrangement is called the "bridging connection."

THIRTY-FIVE-TON ELECTRIC LOCOMOTIVE FOR WOODWARD IRON WORKS.

BY S. T. DODD.

The Woodward Iron Works has recently ordered a thirty-five-ton locomotive from the General Electric Company. This locomotive will be used for hauling coke from its by-products ovens to a point where it is dumped into gondola cars for transmission to the blast furnaces. The locomotive makes about fifty round trips per day, the approximate length of each trip being 2,000 feet and handles approximately twenty tons of coke per trip. There is a three-per-cent grade about 300 feet long.



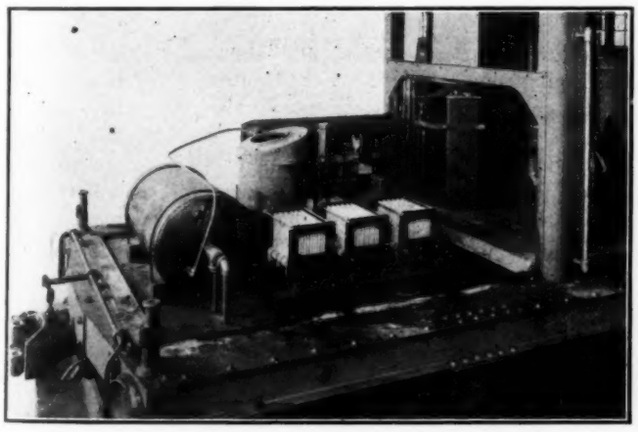
MOTORMAN'S STATION.

The locomotive is a unit designed along the lines of the General Electric Company's standard practice with all-steel framing and cab and with arch-bar truck. It is arranged for slow-speed service and is equipped with four motors wound for 220 volts and with type M single-unit control.

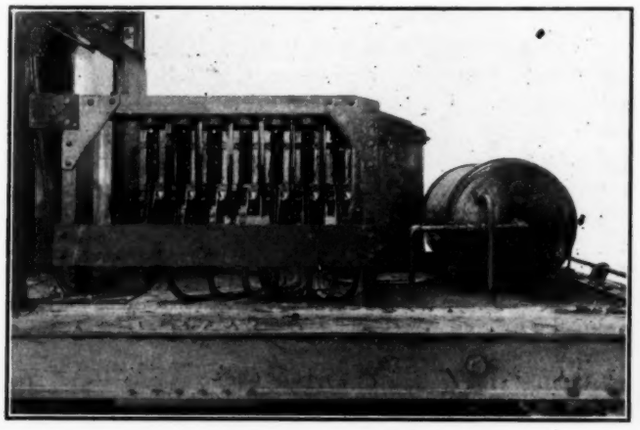
The great rigidity and strength required in locomotive construction combined with the utmost simplicity in design are features characteristic of all General Electric locomotives and are emphasized in the design of this. To illustrate, the platform framing consists of six pieces of channel and two large plates all riveted securely together. Of these, two eight-inch side channels and two seven-inch center channels run the whole length of the platform. A heavy box casting forming the drawhead is riveted between the center channels and to an eight-inch cross channel that forms the end framing. The outer longitudinal channels are also riveted to the same cross channel through forged knees. All this channel framework is connected and squared by two heavy plates, each of which covers half the length of the platform and runs the entire width, forming the floor of the locomotive.

The members of the truck side frame are forged bars four inches wide and of weights proportioned to meet the requirements of the service. Journal boxes are steel castings carried between the top bar and tie bar by 1.25-inch pedestal bolts and fitted with bronze bearings and wedges. Heavy malleable-iron bolster guides are bolted in between top bar and arch bar and a spring plank is riveted to these bolster guides.

Regarding the cab and the apparatus located on the platform, it will be noted that the cab is made up in three sections which are independently attached to the platform. The central cab contains the apparatus directly manipulated in the control of the locomotive



APPARATUS IN PLACE WITH CAB END REMOVED.



ARRANGEMENT OF CONTACTORS.

while the auxiliary cabs contain the auxiliary apparatus.

The accompanying illustrations show the end cabs removed and give a good view of the arrangement of the auxiliary apparatus. At the outer end of the platform are located the air reservoirs and sand boxes. Next to them, the reostats are located on one side, and a bank of contactors upon the opposite side, the latter supported on a channel-iron framework built up from the floor of the locomotive. All wiring in the locomotive is drawn through conduits which are built into the locomotive during construction and are supported in such a manner as to furnish a maximum of support and protection to the wiring.

The conduits and piping in the main cab are bracketed against the walls. There is a false floor of wood in the main cab and all conduits and pipes crossing the cab are cleated to the iron floor and covered by this false flooring.

In the center of the main cab there is an air compressor having a capacity of twenty-five cubic feet per minute when pumping against ninety pounds reservoir pressure. This compressor is controlled by a governor located in the end cab and adjusted to maintain reservoir pressure between the limits of 80 and 90 pounds.

The locomotive is designed to operate at 220 volts at the trolley. The motor equipment consists of four type H motors furnished with cast-steel gears, having seventy-two teeth, and forged-steel pinions, having sixteen teeth, giving a gear ratio of 4.25 to 1. The motors are capable of developing a tractive effort of 10,000 pounds at the rated one hour load with a speed of six miles per hour and all parts of the equipment are proportioned for taking a current sufficient to slip the driving wheels without dangerous overloads.

A US-106 bow trolley is mounted on the cab roof and is arranged for making contact with a trolley wire having a variation in height from 15 to 22 feet above the rail head. The fuse box and lightning arrester are also mounted on the cab roof.

An illuminated duplex air guage is placed at the right-hand side of the engineer's window and is illuminated with a one-candlepower ten-volt shaded lamp inserted in the headlight circuit. Headlights are of the luminous-arc type and are mounted on the main cab directly between the front windows. They are standard, portable street-car headlights and the terminals are plugged into terminal boxes conveniently located under the car roof.

A neat switchboard is mounted in the interior of the main cab occupying the space between the front windows. It contains the switches for the auxiliary circuits, including one main auxiliary switch, two switches for headlights, one for cab lights, one for compressor, and two switches for control circuits. All these auxiliary switches are MS-46 type and each is fitted with a neat name plate indicating the name of the circuit which it controls.

New Factory of Sangamo Electric Company.

The new building of the Sangamo Electric Company, Springfield, Ill., is 160 by 40 by 42 feet, two stories high, of steel, brick and concrete construction. The south end of the lower floor is used for packing and shipping room, instrument-testing room and generator room. The north end down stairs is a machine and tool room and pattern shop. The entrance is through a large hall having on one side a fireproof vault for the storage of master patterns, master plates, records, etc. The south half upstairs is devoted to assembling and general testing rooms and the north half is divided into a general office, private offices and a drafting room.

NEW SANGAMO FACTORY.

The new building is connected on the second floor by a passageway to the old main building, running back at right angles.

The upper floor of the old building is now devoted entirely to light manufacturing work such as the manufacture of coils, recording trains, small brass and steel parts, etc. The east portion upstairs leading to the new building is devoted to inspection and the storage of finished light material. The lower floor of the old main building contains machinery for heavy manufacturing such as milling machines, drill presses, heavy turret lathes, hydraulic presses, punch presses, etc. The east end of the old building downstairs is occupied by the receiving room and store room for raw material.

The brick building with ventilated roof north of the old main building and back of the office building is the forge shop, and japanning room equipped with fuel-oil furnaces, Bliss presses, disk grinders, etc., for the manufacture of all types of permanent magnets—and with very complete equipment of gas-heated ovens for japanning—and baking varnish.

The smallest building to the north is used for the manufacture of molded-insulation parts, being equipped with grinding machinery and hydraulic presses up to 250-tons capacity.

Shelby Day.

Saturday, June 24, was "Shelby Day" at the offices and Engineering Department of the National Electric Lamp Association, Cleveland, Ohio. About fifty of the Shelby Electric Company's employees and several of its officers came down from Shelby, Ohio, arriving in Cleveland at 10 a. m. After registering in the Visitor's Book at the National Club the party devoted the morning to a "Cook's personally conducted tour" of the various departments in and about the Association's Engineering Building, terminating at the restaurant where 150 plates were set for dinner. The afternoon was given up to an athletic meet held at the American League baseball park, which had been specially engaged for the occasion. There was an exciting baseball game between the "Shelbys" and the "National," and sundry novelty races, including one in which incandescent lamp bulbs served as an excellent substitute for potatoes. Robertson's band furnished music throughout the afternoon. Supper was served at 6 p. m. at the National Club, and was followed by a final season of merry-making before the men from Shelby made their adieux. The Committee on Arrangements, of which A. M. Sweeney was chairman, deserved great credit for the success of the affair. In providing this elaborate entertainment, the lamp men of Cleveland were reciprocating the attentions showered upon them on September 12, last, when they were the guests of Messrs. Van Horn, Freund and Caswell in Shelby.

Current Electrical News

COMMISSION NEWS FROM NEW YORK.

(Special Correspondence.)

For the first time in its history, the Public Service Commission for the First District has established rates for a public service corporation at the corporation's request. An order was served by the Commision on the Queensboro Gas & Electric Company, directing that the prices to be charged for gas be lowered and the price of electricity by that company in the Fifth Ward of the Borough of Queens should from July 1, 1911, to July 1, 1912, be thirteen cents per kilowatt-hour, maximum.

The company has been selling electric current at fifteen cents per kilowatt-hour maximum, and three and one-half cents minimum for wholesale power for pumping purposes. The city paid ten cents per kilowatt-hour for municipal lighting and $65 to $100 a year for street arc lamps.

The matter was brought to the attention of the Commission by two complainants, one relating to gas and the other to electricity, and each signed by more than 100 consumers. Although the company showed that it had reduced the rates in previous years and was contemplating a reduction to $1.25 for gas and fourteen cents for electricity for the year 1911, the complainants were not satisfied and brought the matter before the Commission. Shortly after the proceedings began, the company, to avoid a long rate case, asked the Commission to establish maximum rates for the company and agreed to accept such rates as the Commission might establish and put them in force during the year 1911. It promised to "give them a full, fair and complete trial, so as if possible to make of them a success; without prejudice at the end of the year 1911 to any new proceedings that may be instituted."

In fixing the rate, the Commission relied upon the results of its examination into the affairs of the company, so as to assure a fair return upon the value of the property and the capital invested, with due regard to local conditions. Some of the complainants have argued that the Queensboro company should supply them with gas and electricity at the same rates that prevail in Manhattan, or at least in Brooklyn. The company's representatives, however, maintained that the local conditions are entirely different from those in Manhattan and Brooklyn, that the population is not only sparse but fluctuating, and that there is, particularly in the Far Rockaway section, a large summer population and a very small winter population. As a result, a large portion of the plant must remain idle during eight or ten months of the year and unusual expenses must be incurred as the result of such changing conditions. The Commission found that there was merit in this contention. The number of meters in use in August, for instance, were found to be almost double the number in use at the end of December, and consumption during the month of August is four or five times what it is during the winter months. The use of electricity for power is small and miles of mains lie almost idle during the winter. The summer business comes with a rush and is expensive to handle. The Commission decided that it was impossible to disregard these local conditions. It is expected that they will change as the section builds up, and there seems to be no reason why the rates for gas and electricity should not steadily decrease, but at present local conditions must be taken as they exist.

The village of Hunter, Greene County, has petitioned the Commission for an adjustment of certain difficulties that have arisen between it and the Schoharie Light & Power Company. The complaint alleges that the company, on June 1, 1911, shut off the supply of electrical service for street lighting and thereby threatened a great loss to the principal business of the village as a summer resort, and endangers the lives and limbs of those who travel the streets of the village by night. The difficulty exists because of the expiration, on November 1, 1910, of a five-year contract for street lighting which was held by the Schoharie Company. The village alleges that it has elected to exercise the right to renew this contract for a further term of five years at the same price, but that the company refuses to accept the renewal and desires an increased rate. Negotiations for a new contract having finally failed, the company shut off the supply of service and the Commission is now asked by the village authorities to adjust the matter.

IMPORTANT DEVELOPMENT.

A TENNESSEE DEVELOPMENT.—Little River, on Lookout Mountain, fifty-six miles from Chattanooga, Tenn., is to be utilized for supplying electric power for Gadsden, Ala., and a number of other small cities in that section. About $60,000 has already been spent in making surveys and purchasing land which will be overflowed by a proposed dam, and the estimate is that a lake nine miles in length will be formed. It is expected that 20,000 horsepower will be available.

CANADA.

(Special Correspondence.)

OTTAWA, ONT., JULY 1.—The Sherbrooke Railway & Power Company has purchased the interests of the Stanstead Light Company. The former concern will build a line from Sherbrooke, Que., to Stanstead.

The big power companies of Montreal will have to face a new competitor in the Isle au Heron Development Company. This company has acquired the right to develop power in the Lachine Rapids in the St. Lawrence River near Montreal. The hydraulic engineers have valued the capacity of the waterfall at the point to be developed at 40,000 horsepower.

A dispute between the Dominion Government and the Governments of Ontario and Quebec may be the outcome of a proposal now being made for the acquisition by the City of Ottawa of a water power at the Chats Falls on the Ottawa River about thirty-two miles from the city. The power in question belongs to the Hon. William Harty, of Kingston, Ont., and two associates, who demand $100,000 for the falls, which they secured some years ago for $400. It is claimed that the Dominion Government is the rightful owner of the falls in question and has never parted with the title.

Electrical development is making great strides in the city and district of Quebec, and the probability is that, before very long, all the water powers in the district will be fully taxed, and more steam auxiliary plants will have to be erected. A remarkable piece of electrical engineering, which has been under way for the past eighteen months there, is now approaching completion in the shape of a tying together in one power house of the different electrical systems heretofore furnishing light, heat and power to the city and district.

It is stated that the long expected merger of public utilities in the city of Ottawa is about to be consummated. It is said that four companies will be consolidated as follows: The Ottawa Electric Railway Company; the Ottawa Light, Heat & Power Company, which includes the Ottawa Gas Company, and the Ottawa Car Company. A holding company is to be formed with a capital of $10,000,000 bonds carrying interest at three per cent, and $10,000,000 of capital stock, which will only be issued as they are required by the company.

The Montreal Central Terminal Railway, by its charter, granted in July, last year, has to spend fifteen per cent of its $20,000,000 capital within two years, and finish the work within five years in order to keep its charter. The charter gives the company power to construct a belt line of electric railway underground in the city of Montreal. Last year the city contested this scheme, because the proposal then was to make an open cut, and simply cover it over. This plan would have so deranged the sewer and water system of the city that the city would not agree, and the only terms on which the civic authorities will consent are that the route shall be carried far enough below the surface to obviate this danger.

The Shawinigan Power Company, of Montreal, early in 1910 found it necessary, in view of the rapidly increasing market for power, to make arrangements for an extension of the plant at Shawinigan Falls, Que., and plans were laid for a further hydraulic installation that would have an ultimate capacity of 75,000 horsepower, in which connection it was decided to construct another power house. Considerable headway has been made with this additional installation to the plant, which is expected to be completed and ready to deliver power this fall. With this additional development, the company will have a total electrical capacity of 130,000 horsepower, and even with that amount installed will have over 50,000 horsepower in reserve.

A commission of expert hydraulic engineers will shortly be appointed by the Dominion Government to deal, by way of report, with power projects along the St. Lawrence River. Several of these projects have been applied for in the past few years, and immediately a protest has been made by the navigation interests. The Long Sault dam question is held up, and also the project of the Canadian Light & Power Company, which would construct a dam near Clark's Island. The views expressed by the parties are so conflicting, as to the effect that the works will have upon navigation by the diversion of flow, that the Government, even though having competent men of its own, intends to appoint a Royal Commission to go into the whole question and determine what really will be the consequential effects of these schemes. The principle will be asserted that navigation is to be the permanent consideration. Any power development scheme that is found to injuriously interfere with it has little chance of going through. It has been declared that the present plan is insufficient to guard against flooding.

LIGHTING AND POWER.

(Special Correspondence.)

LIBERTY, TEX.—The Liberty Light & Power Company will establish an electric light plant.

OAKLAND, ORE.—The municipality will issue $10,000 in bonds for an electric lighting system.

ALVIN, TEX.—The Alvin Water, Light & Ice Company has been incorporated by L. H. Wallis.

COTTER, ARK.—This city has granted a thirty-year electric light franchise to E. B. Griswold.

RUSHFORD, MINN.—The Rushford Power Company has begun the construction of its big dam.

VIRGINIA, ILL.—The Virginia Light, Heat & Power Company may rebuild its street lighting system. Z.

DELANO, MINN.—George W. Florida will repair the Rockford dam and install an electric light plant. C.

HUMBOLDT, IOWA.—Construction has been started on the big cement dam across the Des Moines. C.

JEWELL, IOWA.—Funds are being solicited for the installation of electrolier lights on Main street. C.

TULARE, CAL.—The Tulare Power Company has applied for an electric lighting franchise in this city. A.

CLARKSVILLE, ARK.—This city is about to begin the construction of its own electric light plant.

PLANKINTON, S. D.—W. A. Kurtz, of Wolsey, contemplates establishing an electric light system here.

FAIRVIEW, S. D.—The Fairview Milling Company proposes to build a dam and generate electric power.

DAYTON, WASH.—The Pacific Light & Power Company has been granted a fifty-year franchise in this place.

CLAVERACK, N. Y.—The Red Hook Light & Power Company has applied for a franchise for lighting this place.

LIBBY, MONT.—The electric light plant now in the course of construction will be in full operation in a short time.

BERRYVILLE, ARK.—The North Arkansas Power Company has been chartered with a capital stock of $100,000.

HERMISTON, ORE.—The Hermiston Light & Power Company has been incorporated with a capital stock of $10,000.

BARAGA, MICH.—It is proposed to take a vote on issuing bonds for $35,000 for the installation of an electric light plant. C.

MOBERLY, MO.—The Randolph County Gas & Electric Company has been incorporated with a capital stock of $20,000.

STOCKTON SPRINGS, ME.—The Penobscot Bay Electric Light Company is installing a street lighting system in this village.

MANSFIELD, ARK.—The Modern Electric Light & Power Company has been incorporated with a capital stock of $100,000.

LA CROSSE, WIS.—Alderman Paul W. Mahoney will present a proposition to the council to install a municipal lighting plant. C.

KALISPELL, MONT.—The Northern Idaho & Montana Power Company will install pressure pumps in its local power plant this season. C.

CENTRALIA, WASH.—The Washington-Oregon corporation is about to install a power plant at Kalema River at a cost of about $750,000. C.

SAUK RAPIDS, MINN.—The Sauk Rapids Water Power Company has commenced construction on its electric light and power dam. C.

LEWISTOWN, MINN.—The Commercial Club will install a permanent illuminating system, including over 2,000 incandescent lamps. C.

WARREN, IND.—The town council has contracted with the Marion & Bluffton Traction Company to light the town with electricity. S.

POLSON, MONT.—The installation of an electric power plant at Hell Roaring River is being considered by Mayor Dawson and others. C.

DAYTON, O.—In a special appropriation made for city needs was included the sum of $25,631 for an ornamental street lighting system.

HAMILTON, IOWA.—The Stone & Webster Corporation is asking for franchises for operating electric-light plants and a street railway. C.

HOOD RIVER, ORE.—W. Evans, J. Watt and H. J. Jackson have incorporated the Hydro Electric Company, of Hood River, for $250,000. A.

PORTLAND, ORE.—The Clatskinie Electric Light & Power Company, Portland, Ore., has been incorporated with capital stock of $50,000.

LISBON, S. D.—The Bemmels Milling Company is considering the installation of a plant to supply the town with electric light and power. C.

POCAHONTAS, IOWA.—Petitions will be presented for another election to vote on issuing bonds for the erection of an electric-light plant. C.

NORTH BRANCH, MINN.—The Eastern Minnesota Power Company, of Pine City, Minn., has been granted an electric-light franchise here.

HOUSTON, TEX.—The Clarendon Light & Power Company was recently incorporated by L. W. Chase and W. M. Odell. The capital is $25,000.

LAKEPORT, CAL.—The Mt. Konocti Electric Light & Power Company has been granted a franchise for an electric power and light line in this town. A.

EUREKA, CAL.—The Western States Gas & Electric Company has asked for a franchise for a transmission line along the county roads of Humbolt County.

SIDNEY, O.—Work has commenced on the remodeling of the Sidney Electric Light Company's plant. New steam and electrical apparatus will be installed.

BEVERTON, ORE.—The Washington-Oregon Corporation of Portland has been granted a franchise for an electric light and power system in this place.

NEWPORT, WASH.—The Northern Idaho & Montesano Power Company has been granted a franchise for an electric lighting system in the town of Newport. A.

DEERWOOD, MINN.—The Cuyuna Range Light & Power Company is arranging to add to the facilities at the water-works plant near the Crow Wing River.

JOHNSTOWN, O.—The Johnstown Water & Light Company was incorporated with a capital of $6,000 by M. R. Thornton, M. M. Huffman, H. Miller and S. S. Myer.

KLAMATH FALLS, ORE.—The Rogue River Electric Power Company has submitted to the City Council a proposition for furnishing the city with electric power. A.

MARION HEIGHTS, PA.—A new system of street lighting has been installed by the Edison Electric Illuminating Company, of Mt. Carmel. Tungsten lights are in use.

MILWAUKEE, WIS.—The Co-operative Electric Company has been incorporated with a capital of $4,000 by H. H. Schermerhorn, Fred J. Schermerhorn and J. A. Mueller.

SALEM, ORE.—The Bully Irrigation & Power Company has been incorporated with a capital stock of $25,000. The company will have its principal office at Vale, Ore.

WILKESBARRE, PA.—A charter has been secured by the Wyoming Lighting Company, which incorporated to furnish this city with electricity for light and power.

BARKER, N. Y.—A fifty-year franchise has been granted to the A. L. Swett Electric Light & Power Company, of Medina. The lights are to be in operation by October 1.

MANSFIELD, MASS.—Bonds to the amount of $22,500 have been voted to make improvements on the lighting plant and meet the demands of increased lighting service.

TOWER, MINN.—Bids will shortly be called for the construction of a dam and electric light plant at Like River, estimated to cost $12,000 to $15,000. D. A. Reed is engineer. C.

ROCKFORD, ILL.—Resolutions asking for the establishment of a municipal electric light plant, offered by socialist members of the council, were vetoed by the other aldermen. Z.

GADSDEN, ALA.—The Alabama Power & Light Company has been incorporated with a capital of $2,000. The incorporators are R. A. Mitchell, E. T. Hollingsworth and T. S. Kyle.

TEMPE, ARIZ.—Application has been made by the Reclamation Service through its local manager, C. H. Fitch, for permission to put a 10,000-volt transmission line through the town. A.

HONDO, TEX.—The Hondo Light, Power & Ice Company was recently incorporated with a capital of $25,000. The incorporators are J. H. Honn, Geo. Muennink and John Muennink.

RIVERSIDE, CAL.—The Pacific Light & Power Company has been granted a fifty-year franchise for an electric lighting line along the public highways of Riverside County, Cal.

BOONE, IOWA.—The electric properties have been sold to W. G. Dows, Isaac B. Smith and John A. Reed, of Cedar Rapids, and elaborate improvements are planned for this and next year. C.

PRESTONSBURG, KY.—The Prestonsburg Electric Light Company has been incorporated with a capital of $6,000. The incorporators are Howard Estell, O. P. Powes and J. H. Spalding.

NEWBERRY, MICH.—The proposal to issue bonds for $11,000 to erect a new power house was defeated, but the village council will expend $4,000 in the installation of additional machinery. C.

MISHICOTT, WIS.—Ira Beyer and others let the contract to the Acker Electrical Company, of Sheboygan, for the installation of a 100-horsepower plant, estimated to cost $10,000 to $15,000. C.

BAY SPRINGS, MISS.—The Bay Springs Electric Light Company was recently incorporated with a capital of $10,000. The incorporators are C. E. Burnham, L. L. Denson and S. A. Denson.

HARTFORD, CONN.—The Hartford Electric Company is engaged in putting its cables underground. It is estimated that the underground system will be completed in less than two months.

SAN FRANCISCO, CAL.—The Mokelumne River Power Company has been incorporated for $3,000,000 by L. Brown, A. H. Elliott,

A. M. Sherman, M. E. Logan and G. C. Elliott, of San Francisco, Cal. A.

HOOD RIVER, ORE.—The Pacific Light & Power Company is enlarging its power plant at this place and will soon furnish light and power to all the farms between Hood River and The Dalles, Ore.

MT. CARMEL, ILL.—The plant of the Mt. Carmel Gas & Electric Company will be sold at auction August 14 by direction of the United States Court for the benefit of the Company's creditors. Z.

SEATTLE, WASH.—The Washington-Oregon Railroad Company is constructing a large power plant on the Skookumchuch River to furnish electricity to the Hercules & Sandstone Company, of Tenino, Wash.

COLUMBUS, O.—An effort is being made by the North Side Chamber of Commerce to replace the arches and arch lights in North High Street by cluster lights. Funds for this purpose are being solicited.

DANVILLE, ILL.—Judge Wright, of the Federal Court, has signed a decree ordering the sale of the Mt. Carmel Electric Light Company's plant to satisfy claims of $250,000. The foreclosure suit was brought on bonds. S.

LAUREL HILL, VA.—Surveys have been made for the location of the dam and power house which is to furnish the city with a supply of hydroelectric power. A tunnel will be dug, cutting across a six-mile bend in the river.

TAYLORVILLE, ILL.—The Taylorville Railway, Light, Heat & Power Company has closed a contract to furnish power to the S. E. Baughman & Sons' flouring mill. Four motors aggregating 120 horsepower will be installed. Z.

GREENCASTLE, IND.—A number of capitalists headed by W. A. Martin, of Laporte, Ind., are said to have bought the Greencastle Gas & Electric Company's plants. The new owners contemplate improving and enlarging both plants. S.

MARQUETTE, MICH.—Improvements are to be made in the electric lighting system, the contract having been let to the Allis-Chalmers Company. The addition of new machinery will more than double the capacity of the plant.

MUNCIE, IND.—The Muncie Heat, Light & Power Company announces that it will abandon the natural-gas field and begin at once to install an artificial-gas plant. All the gas franchises in Muncie are controlled by this company. S.

WARREN, O.—The Trumbull Public Service Company will generate electric power for distribution in Trumbull and Geauga Counties. The capital is $10,000, and the incorporators are C. C. Owens, Ellis R. Diem, Harold T. Clark and others.

BOYD, WIS.—The Boyd Lumber & Implement Company has purchased the electric light plant from Charles Shong & Son. Improvements in service and incidentally improvements in the mechanical part of the plant are to be made.

WALLA WALLA, WASH.—The Pacific Light & Power Company has secured a fifty-year franchise for the construction of a power-transmission line along the county roads from Walla Walla City to Prescott, and has commenced construction work.

SACRAMENTO, CAL.—The Great Western Power Company has been given the contract for lighting the Capitol and Capitol Park. This company has also secured contracts from several of the large manufacturing concerns in Sacramento.

LOS ANGELES, CAL.—The installation of twenty-six new lights, which has been recommended by R. H. Manahan, city electrician, completes the number of 300 new lights allowed under the present street lighting contract, which expires January 1, 1912.

MANHATTAN, N. Y.—F. H. Herring, Inc., has organized with a capital of $15,000 for the purpose of manufacturing engines, electric generators, etc. The incorporators are Frank E. Loghran, Fred H. Herring, Sarah D. Herring, and Charles L. Allen.

NEW LISBON, WIS.—W. S. Sargent, city clerk, will receive bids until 1:30 p. m. July 19 for the erection of an electric light and water-works plant. A check for five per cent of the amount must be sent. August H. Meyer is engineer, Appleton, Wis. C.

SYRACUSE, N. Y.—A campaign is being carried on for the extension of the ornamental system of street lighting through several blocks of the downtown section that are not now covered. Active co-operation on the part of the business men is expected.

LEXINGTON, S. C.—The Lexington Electric Light & Power Company will put its plant in operation about August 1, and work at Barre's Mill, where the plant is located, is progressing rapidly. Light and power will be furnished under a twenty-year franchise.

LODA, ILL.—A contract to light the village has been closed with the Paxton Electric Company, which will operate a transmission line. Matthew Coffey has purchased the lines and poles from the Adden-Morgan Company and will act as resident manager. Z.

MINOT, N. D.—The Consumers Power Company is expending $100,000 in improvements to its plant, including the erection of a two-story pressed-brick office building, 25 by 85 feet, at Third and Main Streets. A switchboard costing $13,000 will be installed in the plant. C.

DURHAM, N. C.—The Pearl Cotton Mills and the Erwin Cotton Mills Company's No. 1 mill soon begin operating by electricity. The former mill has 10,335 ring spindles and 248 broad looms, while the latter operates 25,100 ring spindles and 1,000 narrow looms.

MINNEOLA, L. I.—A mortgage for $6,000,000, given by the Long Island Lighting Company to the Mercantile Trust Company, has been filed. The mortgage covers all the lighting company's property in Suffolk County and in Oyster Bay in Nassau. It is to run until March 1, 1936.

MADISON, N. J.—The contract for rehabilitating the municipal electric plant was awarded to the Blackhall & Baldwin Company, contracting engineers of New York City, for $11,192.75. Work is to begin without delay under the supervision of the New England Engineering Company.

SEDALIA, MO.—An order of foreclosure has been entered in the United States Circuit Court against the Sedalia Light & Traction Company in which the electric company is given forty days after June 27 to adjust its indebtedness of $807,000 to the City Trust Company of Boston. Z.

RALEIGH, N. C.—The Executive Committee of the state hospital adopted a motion in favor of establishing an electric light plant at the hospital. The executive committee is composed of Mr. S. O. Middleton, of Hallsville; Mr. S. G. Daniel, of Littleton; and Dr. E. G. Moore, of Elm City.

DALTON, GA.—A franchise has been asked for the East Tennessee Power Company. The company, which is developing the water power on the Ocoee River, will have its line run to this city and will be ready to sell power by September 1, provided the franchise can be secured.

LEBANON, NEB.—The West Lebanon Light & Power Company has been granted a perpetual charter to supply light, heat and power to West Lebanon. The capital of the company is $5,000, and its directors are Daniel Weaver, Jacob Weaver, Henry Weaver, Raymond S. Bicksler and others.

HOLLISTER, CAL.—The San Benito County Light & Power Company, which supplies Hollister with electricity, has changed hands, and will in the near future be under the direction of the Coast Counties' Light & Power Company. It is understood that the company will not take immediate charge.

EUREKA, CAL.—The Western States Gas & Electric Company, recently purchased the holdings of the Fortuna and Ferndale lighting companies of this county and is now making improvements throughout the entire system. The substation at Loleta will be moved to a better location further up the river.

LITTLE ROCK, ARK.—A charter has been given to the North Arkansas Power Company, which was incorporated with a capital of $100,000 to develop electric power from streams in northern Arkansas. The directors are J. R. Neff, president; E. H. Ingram, Ellis D. Munger and W. D. Wilton, and the place of business will be Berryville.

ELKHART, IND.—The Indiana & Muncie Electric Company has made plans to rebuild the dam on the St. Joseph River and to erect a power house with a developing capacity of 2,500 horsepower. The work will require eighteen months for completion. The company was organized in 1867 and proved a big stimulus to the city's industrial growth. S.

TULARE, CAL.—C. H. Holly, chief engineer of the Tulare Power Company, is engaged on the work of constructing the main canal which will take water from the Tule River near Springfield to the power house at Globe. He is also planning for substations and for the construction of an auxiliary steam plant for use in emergency.

ELKHART, IND.—A new dam is to be constructed across the St. Joseph River just below the present structure east of the Elkhart Avenue bridge, while at the south side of the river and forming part of the new dam will be constructed a large modern power-house with waterpower and steam equipment capable of developing 7,500 horsepower.

RENO, NEV.—The Nevada Power & Transportation Company will soon begin work on an eighteen-foot dam in the Truckee River near Vista where it will build a new power plant. This company is also putting up a large plant at Bishop, Nev., and at several other points, and expects to soon be in a position to bid for considerable new business.

WEBSTER CITY, IOWA.—The contracts for items No. 1 to 4, including engines, boilers, piping and heaters, in the installation of a municipal light plant, have been let to the Murray Iron Works, of Burlington, Iowa, at $12,800, and for the electric generators and switchboard to the Westinghouse Electric & Manufacturing Company, of Pittsburg, Pa., at $9,998. C.

VERA CRUZ, MEX.—At the annual meeting of the shareholders of the Vera Cruz Electric Light, Power & Traction Company, Ltd., which was recently held in London, England, it was recommended that a hydroelectric plant be erected to supply power for the company which operates the electric lighting system as well as the street railways of this city. D.

RUSSELLVILLE, ALA.—The putting in of a water and light plant for Russellville in the near future is a certainty. Contracts

for putting it in and having it in operation by or before November 1 were signed by the contractor, W. W. Moore, of Birmingham, on one hand, and the board of mayor and aldermen of Russellville on the other. The consideration is $24,000 in city bonds.

ZIMAPAN (HIDALGO), MEX.—Andrew Mackenzie, of Mexico City, has been granted a concession by the Government for the installation of a large hydroelectric plant and the construction of transmission lines to run to this mining district and other industrial centers of the state. The concession authorizes him to use the waters of the Moctezuma and Tula Rivers for generating the electric power. D.

ALVIN, TEX.—The charter for the Alvin Water, Light & Ice Company has been received and the stockholders have elected the following directors for the first year: W. D. Newbill, M. S. French, L. H. Wallis, F. L. King, T. P. Majors, Z. C. Sedwick, H. P. Rhodes, S. Jones and R. H. King The directors elected C. Z. Sedwick, president; M. S. French, vice-president; T. P. Majors, secretary and treasurer.

TRENTON, N. J.—The Republic Railway & Light Company, with $17,500,000 capital, has been incorporated by M. Gregg Latimer and William Henry Hoyt, of Brooklyn, and John B. March, of New York. The company will run a general electric and gas, heat, light and power business, and will take over the Mahoning & Shenango Railway & Light Company, a Pennsylvania corporation, with $10,000,000 capital stock.

HORNITAS, CAL.—Power plants have been recently installed in the Quartz Mountain district and electric lighting systems established here. A five-mile high-tension line built by the San Joaquin Light & Power Company runs through Hornitas to the Doss and Thorn Mine, and power pumps electrically furnish water for the mine. The engines which were formerly used in connection with the hoists have been abandoned and motors installed in their place.

BOISE, IDAHO.—It is probable that the transmission line of the Beaver River Power Company will be extended from the Malad River plant, northward, being completed about October. The plant being constructed on the Malad River will have an ultimate development of about 20,000 horsepower. The present plant installation will have a capacity of about 10,000 horsepower. The principal use of the power will be in pumping water upon land which cannot be irrigated by the gravity system.

ST. LOUIS, MO.—The transforming plant for the transmission line of the North American Company from the Mississippi River dam at Keokuk to St. Louis probably will be built between Normandie and Suburban Garden, but may be placed at Shrewsbury. Charles Ruffner, formerly of Palmyra, Mo., but more recently with the Telluride Power Company in Utah, has been appointed engineer in charge of building the transmission lines. The transforming station and line will be owned by the Mississippi River Distributing Company, which will buy power from the Mississippi River Power Company and sell it to the United Railways and the Union Electric Light & Power Company. Z.

DALTON, GA.—L. F. Joerissen, of Atlanta, representing the Georgia Power Company, recently interviewed the various manufacturers of the city relative to the amount of power used. It is understood that the Georgia Power Company will ask the City Council for a franchise to bring its lines into Dalton. If this franchise can be obtained, it is announced that the Georgia Power Company will be furnishing power to this city by the fall of 1912, bringing its power from Tallulah Falls. The proposed line will run from Atlanta to Dalton by way of Marietta, Cartersville and Calhoun. Should the company come to Dalton, it will have as a competitor the Eastern Tennessee Power Company. I.

CEDARTOWN, GA.—A deal was recently closed between the Georgia Power Company, of Atlanta, and Gen. J. O. Waddell, of this place, whereby a site has been given the power company at Aragon for a transforming station. The full current will be brought from Tallulah Falls by way of Atlanta to Aragon, where the transforming station will divide it, a part coming to Cedartown and a part going to Rome, Ga. It is anticipated that this power in this section will greatly aid in building the proposed trolley line from Cedartown, taking in Rockmart, Aragon, Cartersville, Rome, Cave Springs, and then back to this place. The idea of a trolley line in this section has been received with much enthusiasm. I.

ELECTRIC RAILWAYS.

(Special Correspondence.)

MORRIS, MINN.—An electric railway to Ortonville, via Synnes, Hegbert and Appleton is proposed. C.

COFFEYVILLE, KANS.—The Union Traction Company proposes to extend its lines to South Coffeyville.

DES MOINES, IOWA.—The Traction Company is planning the expenditure of $500,000 in improvements this year. C.

KANKAKEE, ILL.—The headquarters of the Kankakee-Urbana Traction Company will be removed from this city to Urbana. Z.

PINE ISLAND, MINN.—The Interurban Construction Company has applied for an electric-line franchise through this village.

REDWOOD CITY, CAL.—Edward S. Fitzpatrick has been granted a franchise for an electric line from Redwood City to Woodside, Cal. A.

WATERLOO, IOWA.—The Waterloo, Cedar Falls & Northern is planning to construct interurban lines to La Porte and other towns near here.

CHICO, CAL.—The Northern Electric Railway Company has been granted a franchise for an electric railway along certain streets of this town. A.

AUSTIN, TEX.—The Amarillo Traction Company, of Amarillo, has been incorporated with a capital stock of $24,000. The incorporators are Mark Logan, W. W. Lynch and N. A. Brown.

BISHOP, CAL.—Graders are now at work on the line of the Owens Valley Electric Railway connecting this place with the Southern Pacific at Laws, Cal. A.

PUYALLUP, WASH.—The Tacoma Railway & Power Company is having plans prepared for the erection of a depot, construction on which will be started shortly. C.

LODI, CAL.—The Central California Traction Company has been given a forty-seven-year franchise for a single-track, standard-gauge line along certain of the public roads of San Joaquin County, Cal.

ST. PAUL.—The St. Paul Railway Promotion Company has let the contract for the construction of an interurban line between Hastings and Inver Grove and work will be started by the end of July. C.

SAN FRANCISCO, CAL.—It is reported that the British Electric Traction Company, through its local agent, will file an application for a franchise for an underground railway from the ferry depot to Golden Gate Park. A.

AUSTIN, TEX.—Articles of incorporation have been filed for the Waco Stree Railway Company, capitalized at $1,000,000. The incorporators are J. F. Strickland, Osee Goodwin and M. B. Templeton, all of Dallas.

EUGENE, ORE.—The Portland, Eugene & Eastern Railway has obtained the right-of-way for several miles of the electric line soon to be built between Eugene and Corvallis, Ore. Construction will begin about the first of December. A.

SOUTH BEND, WASH.—The work of the Twin City Light & Power Company of extending its road between this city and Raymond has been started, and according to officials of the company will be pushed to completion.

CAPE GIRARDEAU, MO.—Directors of the Cape Girardeau & Jackson Interurban Electric line have authorized a survey for an extension to Jackson, Illmo, Edna, Chaffee and other towns where the right-of-way already has been secured. Z.

WOODLAND, CAL.—The Vallejo & Northern Railroad will, in a very short time, begin construction work on its line between Woodland and Sacramento and has made application for a franchise along the main street of Woodland.

BIRMINGHAM, ALA.—The first rail has been laid on the electric road which is to run between this city and Ensley. It is expected that the line will eventually be extended to Tuscaloosa in one direction and Gadsden in the other.

OMAHA, NEB.—The Omaha, Sioux City & Northern has let the contract to the Kansas Construction & Irrigation Company, Garden City, Kans., for the construction of ninety miles of interurban road to Sioux City, via Blair, Tekama and Decatur. C.

MARTINSVILLE, IND.—Meetings are being held by the citizens of Monrovia, Hall and Eminence to organize a company to build an electric railway from Morresville to those places. The farmers along the line are taking stock subscriptions and will assist to finance the road. They are anxious to secure electric service. S.

SOUTH BEND, IND.—The board of directors of the Chicago, South Bend & Northern Indiana Railway have approved plans to double-track the remaining portions of the city lines and also for the separation of the terminals of the interurban and city lines. The directors made appropriations for other important improvements. S.

JOLIET, ILL.—The Illinois Traction System has let the contracts for three substations on the new line of the system from Morris to Joliet, to Decatur firms, the amount of the contracts being about $5,000. The substations will be erected during the present season.

BOISE, IDAHO.—The Boise-Council-Landor Railroad has been incorporated by John H. Haines, E. W. Bowman, J. S. D. Manville, Harry Wyman and George Huebener, with a capital stock of $2,000,000. Preliminary surveys have already been made between Boise, Council and Landor. A.

MARSHALL, TEX.—The Marshall Traction Company is arranging to make extensions and improvements. Its line in North Marshall will be extended about one mile. The people of that portion of the city have raised a liberal bonus in money which will be given in aid of the proposed extension. D.

WASHINGTON, IND.—The City Council has granted a fifty-year franchise to the Vincennes, Washington & Eastern Traction Company, which is ready to let a contract for the construction of an interurban railway from Vincennes to Loogootee by way of Washington and other intermediate towns and cities. S.

PITTSBURG, PA.—Bids were asked a short time ago on the

construction of fifteen miles of electric railroad between Blacksville, W. Va., and Waynesburg, Pa. The work is to be started this month and rushed to completion. This will make the first leg of the new Fairmont & Pittsburg Railroad into Pennsylvania.

SAN JOSE, CAL.—Franchises covering twelve miles of road in various parts of Santa Clara County have been granted to the Peninsula Electric Railroad. It is announced that these franchises are in line with the effort of the Southern Pacific Company to obtain a network of electric lines along the peninsula from San Francisco to San Jose. A.

FAIRMONT, W. VA.—The Charleston-Dunbar Traction Company was recently incorporated with a capital of $150,000 to build and operate a traction line. The incorporators are Ferd Paul Grosscup, Paul R. Grosscup, W. C. Davisson, J. Gluck and H. D. Rummell, all of Charleston.

COREY, ALA.—The Tennessee Coal, Iron & Railroad Company has placed an order with the General Electric Company for four eighteen-ton alternating-current locomotives. These will be 220-volt, three-phase, twenty-five-cycle locomotives and their service will consist chiefly of switching and placing cars in and about the company's plant at Corey.

MORGANTOWN, W. VA.—Work has been started on the proposed Mount Morris-Maidsville trolley road, and will probably be rapidly carried out. The total cost of construction will probably not exceed $100,000, and the company is to be incorporated with $12,000 capital. The incorporators are W. K. Hatfield, Thomas Keenan, John Long, Rufus Lazzelle and P. Bowley.

INDIANAPOLIS, IND.—Articles of incorporation have been filed in the office of the secretary for the Kokomo, Frankfort & Western Traction Company, which will build a traction line between Kokomo and Frankfort, through West Middleton, Russiaville, Forest, Michigantown and Avery. The headquarters of the concern are to be in Kokomo. The company is capitalized at $10,000.

OAKLAND, CAL.—Engineers are now surveying a line for the Oakland & Antioch Railroad from Walnut Creek to Oakland. If the present plans are carried out a new tunnel will be built which will shorten the distance between Oakland and Walnut Creek and reduce the grade about two per cent. Nothing definite has been decided upon, as the engineers' reports are not all in shape yet. A.

WAXAHACHIE, TEX.—The City Council of Waxahachie has granted the Stone and Webster Engineering Corporation, of Boston, Mass., a fifty-year franchise for the construction and operation of an electric street-railway line over certain streets there. The local system is to be a part of the interurban electric line which the company will construct between Dallas and Waxahachie, thirty miles apart. D.

YOUNGSTOWN, O.—Reports are current that a gigantic consolidation of suburban lines out of Cleveland and through to Pittsburg is contemplated. It is said that by building a short twelve-mile line from Leavittsburg to Hiram, to connect the Mahoning and Shenango lines with the Cleveland lines would make a through line to Pittsburg. Harrison Williams of New York is reported to own the stock. H.

BRAZIL, IND.—The City Council has made a five-years' contract with the Terre Haute, Indianapolis & Eastern Traction Company for lighting the streets at the rate of $67 per lamp per year on an all-night schedule. The present contract with the Brazil Electric Company expires next April, and as the city desires to install a municipal plant the council refused to make a contract for a longer period than five years. S.

NEW ORLEANS, LA.—Property owners between Metairie Ridge and Kenner have started a movement looking to the building of an electric line between these places. Much of the capital needed to carry out the enterprise has been subscribed, a plan having been devised by which those who are unable to subscribe for stock may give land to some one who will put up the equivalent in cash. The new line will be started within a few weeks. I.

PARKERSBURG, W. VA.—A petition has been filed for the completion of the unfinished line of the Ohio Valley Electric Company between Sistersville and Friendly. The contract calls for the completion of the road at a cost of approximately $14,000. The road is to be completed and ready for rolling stock within sixty days. The contract has been approved and will take effect with the execution of the contractor's bond for $12,000 before the United States clerk in this city.

FREMONT, O.—Traffic on the new Fostoria and Fremont electric line was inaugurated June 22. The round trip between the towns will consume three hours until after the road is thoroughly ballasted and all wires put up. The date for the establishment of the limited service between Lima and Cleveland has not been definitely fixed, but it is hoped it will be inaugurated before the end of the month. The new road will be operated in connection with the Western Ohio Railroad. H.

FORT WORTH, TEX.—The Fort Worth Southern Traction Company has been organized with a capital stock of $1,500,000 for the purpose of constructing and operating an interurban electric railway between Fort Worth and Cleburne, Tex., a distance of about thirty-two miles. The survey for the proposed line has been made and the right-of-way secured. The contract for the construction work will soon be let. The incorporators are C. H. Clifford, W. C. Forbes and W. A. Hanger, all of Fort Worth. D.

OAKLAND, CAL.—The San Francisco, Oakland & San Jose Railway Company, owners of the "Key Route" interurban system is making plans for the improvement of its Oakland and Berkeley lines which will result in a better running time of trains and greatly facilitate the handling of passengers. The present Key Route pier will be converted into a solid mole, the depot and slips at the end of the mole will be enlarged, and all trains run through the depot on a loop, constructed on a solid foundation of earth and concrete instead of piles. A.

INDIANAPOLIS, IND.—Articles of incorporation have been filed for the Indianapolis, Chicago & Meridian Railway Company, organized for the purpose of building an electric line from this city to Chicago. At present it is planned to build the line from Indianapolis to Sheridan and then to Flora, Monticello, Francesville, Valparaiso, Hobart, Wheeler, Gray and Hammond. Later it will be extended to Chicago. The directors of the company are John C. Billheimer, John A. Shafer, Howard Holton, M. B. Keller and M. J. Moreland. It is capitalized at $100,000.

SHARON, PA.—It is announced that Pittsburg men will finance an electric line between Buffalo and Pittsburg. The line will begin at Butler and run on a private right-of-way via Slippery Rock, Grove City, Mercer, Polk, and thence up the French creek to Meadville and Cambridge Springs, and then due north to Erie, passing Edinboro and Middleboro on the way. From Erie the Lake Shore & Buffalo electric line to Buffalo will be used. The entrance to Pittsburg will be over the Butler short line, which is now in operation. The promoters propose to merge the Pittsburg and Butler line with the new road, making it a single line under the one management with double-track facilities much of the way to Buffalo. The extension proposed would be 128 miles from Erie to Butler, and the entire distance from Pittsburg to Buffalo would be shorter than any steam road now operating between these points. It will necessitate the expenditure of from $3,000,000 to $5,000,000 to complete the road and buy the rolling stock, build power houses and other equipment.

TELEPHONE AND TELEGRAPH.

(Special Correspondence.)

CORNING, CAL.—The franchise has been granted for a telephone system in the city of Corning.

LIVINGSTON, MONT.—The Automatic Telephone Company has commenced construction of a line to Clyde Park. C.

WINNEBAGO, ILL.—The Home Telephone Company has leased the old Lewis Hotel building to house its exchange here. Z.

MURRAYVILLE, ILL.—The Central Union Telephone Company is extending its Woodson-Murrayville toll line to Manchester. Z.

MANDAN, N. D.—The North Dakota Telephone Company is arranging for new telephone lines north and south of the city. C.

CLEVELAND, OKLA.—The Enterprise Telephone Company has been incorporated by T. M. Fishburn and others at Norman, Okla.

RANDOLPH, NEB.—The Northwest Farm Line, with a capital of $1,000, has been incorporated to establish a telephone line by J. W. Stuckal and others.

PETALUMA, CAL.—Many of the farmers between Marshall and Petaluma, Cal., are negotiating for a rural telephone line connecting their places with the above-named towns.

WELLS, NEV.—C. G. Wintershaving has filed application for a permit for a telephone line from the state line of Nevada and Idaho, commencing at Rattlesnake Spring on Wilkin's Island.

MANSFIELD, ARK.—The Southwestern Telephone & Telegraph Company will commence, in a short time, the rebuilding of its plant here. New cables and a new switchboard will be installed.

SEARCY, ARK.—The Searcy Telephone Company has sold its system to A. L. Waterbury, of Mason City, Ia. Mr. Waterbury took charge on July 1, and is carrying out improvements begun by the former management.

MANCHESTER, CONN.—The Southern New England Telephone Company is arranging to extend the service towards the north and new cables are to be strung. The cables have arrived and work will soon be started.

NAPOLEON, O.—The Napoleon, O., Home Telephone Company's plant was sold on June 30 by Receiver R. P. Brown to W. L. Parmenter, a Lima attorney, for $21,100, subject to the court's approval. The Morgan interests are said to be concerned. H.

ILO, IDAHO.—A rural telephone company, to be known as the Salmon River Cooperative Telephone Company, has been organized to construct a sixteen-mile metallic circuit system from here to the mouth of Maloney Creek on Salmon River. The officers are: Bert Tefft, president and manager; Thomas Stevens, secretary, and W. A. Miller, treasurer.

WAYCROSS, GA.—Nearly 200 miles of open wiring has been torn down in Waycross by the Southern Bell Telephone Company to make way for the cable system the company is installing. The improvement covers the entire city and will represent an expenditure of $15,000. To keep up with the continued growth of the local exchange two new switchboards are to be installed and more operators employed.

ELECTRICAL SECURITIES.

The United Railways & Electric Company, of Baltimore, has sold to Alexander Brown & Sons, of Baltimore, $3,125,000 three year five-per-cent collateral notes, due July 15, 1914, convertible into common stock at $25 per share. The notes will be offered at ninety-eight and one-half.

Holders of International Traction Company fifty-year four-per-cent collateral trust bonds are notified that semiannual interest on the bonds, which matured on July 1, 1910, will be paid upon presentation of coupons at the office of J. P. Morgan & Co., New York City, on and after July 1, 1911, together with five per cent interest thereon for the year ending July 1, 1911.

Blodget & Company, New York City, are offering the unsold balance of the $1,492,000 issue of Mutual Union Telegraph Company first mortgage entended gold fives, the greater part of which have been sold, at 104 and interest yielding four and three-quarters per cent. The bonds are dated May 1, 1881, and mature May 1, 1941, and are guaranteed by Western Union Telegraph Company, which has a ninety-nine year lease on the porperty. The bonds are secured on main trunk lines of the Western Union system from New York City northerly to Providence, Boston, Albany, Rutland and Buffalo; westerly to Cleveland, Detroit, Chicago, Milwaukee, Minneapolis, St. Louis and Kansas City; southerly to Philadelphia, Baltimore and Washington.

DIVIDENDS.

Bell Telephone Company of Pennsylvania; quarterly dividend of one and one-half per cent, payable July 15. .

Edison Electric Illuminating Company, of Boston; regular quarterly dividend of three per cent, payable August 1 to stock of record July 15.

Electrical Utilities Corporation; regular quarterly dividend of one and one-quarter per cent on the preferred stock, payable July 15 to stockholders of record June 30.

Norfolk & Portsmouth Traction Company; quarterly dividend of one and one-quarter per cent on preferred stock, payable July 10 to stock of record June 30.

San Diego Consolidated Gas & Electric Company; quarterly dividend of one and three-quarters per cent, payable July 15.

United Light & Railways Company, of Portland, Me.; dividends of one and one-half per cent on the first preferred stock and three-quarters of one per cent on the second preferred stock, payable July 1.

West Penn Traction Company; quarterly dividend of one and one-half per cent, payable July 15.

York Railways Company, initial semiannual dividend of fifty cents per share on the preferred stock, payable July 21 to stock of record July 10.

CLOSING BID PRICES FOR ELECTRICAL SECURITIES ON THE LEADING EXCHANGES AS COMPARED WITH THE PREVIOUS WEEK.

NEW YORK.

	July 3.	June 26.
Allis-Chalmers common	8	8½
Allis-Chalmers preferred	29½	29
Amalgamated Copper	69½	71⅛
American Tel. & Cable	*78	78
American Tel. & Tel.	139⅛	149⅛
Brooklyn Rapid Transit	81⅝	80⅜
General Electric	161	163½
Interborough-Metropolitan common	17½	18
Interborough-Metropolitan preferred	50	51
Kings County Electric	129	129
Mackay Companies (Postal Telegraph and Cables) common	89	89
Mackay Companies (Postal Telegraph and Cables) preferred	74	74⅛
Manhattan Elevated	133	134
Metropolitan Street Railway	*18	*18
New York & New Jersey Telephone	103	103
Pacific Tel. & Tel.	49¼	79⅜
U. S. Steel common	78⅝	118½
U. S. Steel preferred	118¼	79⅝
Western Union	78½	76½
Westinghouse common	75¼	76½
Westinghouse preferred	111	*118

*Last price quoted.

BOSTON.

	July 3.	June 26.
American Tel. & Tel.	139⅛	149⅛
Edison Elec. Illuminating	280	284
General Electric	161	164
Massachusetts Electric	22¾	22½
Massachusetts Electric preferred	93¼	91½
New England Telephone	145	146
Western Tel. & Tel. common	18½	18¾
Western Tel. & Tel. preferred	96½	96½

PHILADELPHIA.

	July 3.	June 26.
American Railways	43½	43¾
Electric Company of America	12⅛	12
Electric Storage Battery common	53¾	54⅛
Electric Storage Battery preferred	53¾	54⅛
Philadelphia Electric	17¼	17¼
Philadelphia Rapid Transit	19¼	19
Philadelphia Traction	86	86¾
Union Traction	49	49

CHICAGO.

	July 3.	June 26.
Chicago Railways, Series 1	85	80
Chicago Railways, Series 2	27½	20½
Chicago Subway	4	3¾
Chicago Telephone	121	124
Commonwealth Edison	129½	129
Metropolitan Elevated common	25	26½
Metropolitan Elevated preferred	74	73½

PERSONAL MENTION.

THEODORE N. VAIL, president of the American Telephone & Telegraph Company, recently received the degree of Master of Arts from Dartmouth College.

H. HARVIE has resigned from his position in the engineering department of the Ontario Power Company, Niagara Falls, to take a position with the Lake Superior Power Company as designing engineer.

FRANK W. HALL, manager of the Philadelphia Office of the Sprague Electric Works, has been appointed manager of hoist sales and after July 15, 1911, will be located at the New York office.

H. W. CHASE, formerly in the new business department of the Union Gas & Electric Company, of Cincinnati, and later of Dayton, O., has become connected with the Binghamton Light, Heat & Power Company, of Binghamton, N. Y.

G. W. REDFIELD, of the General Electric Company, gave a talk on "Motors and Generators" at the last meeting of the Electric Club, held at the Superior Commercial Club in Superior, Wis. The address was illustrated with lantern slides.

CLARENCE H. MACKAY, president of the Postal Telegraph & Cable Company, entertained the Postal Telegraph & Cable Company's Branch Office Managers Association at its fourth annual outing at College Point. A party of about two hundred was present.

FRITZ A. LINDBERG has been taken into the firm of Brill & Gardner, mechanical and electrical engineers, of Chicago, Ill. Mr. Lindberg has been associated with this office since his graduation from Armour Institute of Technology ten years ago, having had charge in that time of a large amount of important design and construction work.

JAMES A. CLIFFORD, manager of the Baltimore office of the Sprague Electric Works, has been appointed manager of the Philadelphia office and took charge there on July 1, 1911. The Baltimore office will be continued as in the past under Mr. Clifford's direction, but as subsidiary to the Philadelphia office and with Henry S. Patterson in charge.

ALFRED H. COATES, president of the Colonial Electrical Agency Company, of San Francisco, Cal., expects to leave early in July on his annual eastern trip. He will spend some time in Warren, O., at the headquarters of the Colonial Electric Company and the Economy Electric Company, both of which concerns are represented on the Pacific Coast by Mr. Coates' company.

H. F. THOMSON has been appointed research associate in the Massachusetts Institute of Technology to carry on the work of investigating the relative reliability and costs of operation of electric vehicles as compared with other motor vehicles and horse-drawn vehicles. The Edison Electric Illuminating Company of Boston has offered $3,000 to conduct this work, which will be under the direction of Professor Pender.

GEORGE H. WHITFIELD, who has for many years been general superintendent of the lighting and traction properties at Richmond, Va., has recently given up his work of management to devote himself more particularly to consulting engineering, but in the latter capacity will be retained for all the Gould properties in Virginia, including the plants at Richmond, Petersburg, Norfolk and Fredericksburg. Mr. Whitfield graduated from Richmond College, 1892, and from Cornell University, 1896. He went at once into the street railway field, being connected with manufacturing and with management and becoming superintendent of shops for the United Railways of Baltimore in 1899, remaining there until 1901. He was also general superintendent for a year of the San Francisco and San Mateo road, during which period negotations were pending that resulted in the formation of the United Railroads of San Francisco. On going to Richmond in 1902, Mr. Whitfield found a large opportunity waiting for him, including the enlargement of power houses, the erection of sub-stations, construction of transmission lines to Petersburg, construction of new cars and the installation of hydraulic and steam turbines. One of the most important of his works was the elimination of electrolysis from the water-pipe system of Richmond; the situation in that city being particularly bad due to the lack of proper bonding in the pioneer stages of electric railway development, dating back to the introduction of the Sprague system in 1888. It may be said that the evil has practically been cured. In addition to this work Mr. Whitfield has been engaged in the designing of the electrical features of several plants, including that of the Emporia Hydro-Electric Company and the Richmond and Chesapeake Bay Railway Company. Mr. Whitfield is a member of the American Institute of Electrical Engineers and has represented his company actively in the National Electric Light Association for some time.

OBITUARY.

WILLIAM N. ESTABROOK died unexpectedly, on June 29, of valvular heart disease in the directors' room of the Elmira Mechanics' Society, of which he was president. Mr. Estabrook was instrumental in the establishment of telephone systems in Southern New York and Northern Pennsylvania, and for many years was president and general manager of the New York & Pennsylvania Telephone & Telegraph Company.

LEGAL NOTES.

WHEN A TELEPHONE SYSTEM IS PERSONAL PROPERTY.—The question having been raised whether a privately owned telephone system should be treated as real or personal property on the death of the owner, the Supreme Court of Nebraska holds that, by imposing a limitation of ten years as to the time within which the poles and wires of the system might occupy the streets and public grounds of the city, and by reserving the right of the city to cause the poles and wires to be removed during the term the idea is carried that the property is personal. The taxing of the property as personalty by the city officers, the execution of a chattel mortgage upon the system by the owner to secure a debt, and the fact that the owner never had attached the system to any real estate owned by him, indicate that all the parties to the contract treated the property as personal, and this, together with the act of the owner is held to have fastened that character upon it and determined the course of its descent upon his death.—Zimmerer vs. Stuart, 130 N. W., 300.

NEW INCORPORATIONS.

SAN MARCO, TEX.—The Excelso Storage Battery Company has been incorporated with a capital of $10,000 by A. B. Rogers, A. E. Lawrence and P. A. Hofheinz.

TULSA, OKLA.—The Dodge Electric Company has been incorporated with a capital of $2,000. The incorporators are C. A. Veale, J. E. Dodge, and G. P. Dodge.

MANHATTAN, N. Y.—The W-T Electric Company was recently incorporated with a capital of $25,000 to manufacture electrical specialties. The incorporators are Charles McChapman, Bertram T. Wiltberger, and Ernest B. Traflow.

CLEVELAND, O.—The General Engineering Company has been incorporated to do general electrical manufacturing and equipment. The capital is $10,000 and the incorporators are as follows: E. E. Beam, C. W. Hartley, C. K. Fauver, Vernon E. Davis and Walter S. Sapp.

LOGANSPORT, IND.—The Stanley Differential Hub Company has incorporated to establish a plant to manufacture all parts of machinery used and operated in automobiles, and to manufacture electrical devices and supplies of all kinds. The capital stock is $60,000. E. D. Morgan, G. W. Stanley, Zachary Taylor and Joseph Taylor, directors. S.

ST. LOUIS, MO.—The Electric Resistance Company has been incorporated with capital stock of $2,000 to manufacture and deal in all kinds of supplies used for resistance conductors and all other kinds of electrical devices. The incorporators are William A. Phillips, Frank M. Rumbold, Jefferson City; James H. McCord, St. Joseph; Ralph L. Smith and A. V. Reyburn, Jr. Z.

PROPOSALS.

WIRING.—The office of the Supervising Architect will receive bids for installing wiring and fixtures in post offices according to the items given below:

Work—	Place—	Date.
Wiring	Chicago Heights, Ill.	July 31
Wiring and fixtures	Sulphur Springs, Tex.	August 4
Wiring and fixtures	Princeton, Ind.	August 3
Wiring and fixtures	Ironton, Ohio	July 17
Wiring and fixtures	Waterville, Me.	July 20

Drawings and specifications may be obtained from the custodian at the post office site or from the office of the Supervising Architect.

NEW PUBLICATIONS.

THE FLOW OF STREAMS.—The University of Wisconsin has published a bulletin entitled "The Flow of Streams and the Factors that Control It," with special reference to Wisconsin conditions. The principles that govern stream flow have been taken up in some detail and special effort has been made to show clearly by actual example the results due to known conditions. An important feature of the publication is the report of the study made of the actual relations of rain fall to stream flow on several Wisconsin rivers for considerable periods. It was sought to determine in this way, whether or not such relation has been modified by other progressive causes such as de-forestation, cultivation, etc.

SAMPLING AND ANALYSIS OF FURNACE GASES.—This publication, issued by the Bureau of Mines, describes the methods used in use at present for this work. If conditions, the authors state, are to be improved, they must be more thoroughly understood, and means must be found to insure complete combustion of the fuel, and yet to permit operation with such an excess of air as will result in the greatest efficiency. In this work the services of the chemist are indispensable. A very important problem is the determination of the small percentage of unburned combustible matter that escapes from the furnace in the flue gases. Under ordinary circumstances so little as 0.1 per cent of unburned combustible matter in a furnace gas is equivalent to about 1 per cent of the fuel used; and for the determination of such small percentage of gas more accurate and refined methods are required than have ordinarily been available before. This bulletin, which is No. 12, may be obtained by those interested by writing to the Director of the Bureau of Mines, Washington, D. C.

INDUSTRIAL ITEMS.

MATHIAS KLEIN & SONS, Chicago, Ill., have issued their new catalog, No. 10.

THE EASTERN ELECTRIC LAMP COMPANY, Boston, Mass., is sending out mailing cards advertising the Eastern drawn-wire type Mazda lamp.

THE REPUBLIC ELECTRIC COMPANY, Chicago, Ill., announces that on June 15 its offices were moved to the Electrical Building at 617-631 West Jackson Boulevard.

THE UNITED ELECTRIC APPARATUS COMPANY, Boston, Mass., announces that James W. Foster has been elected treasurer in place of H. Rambonnet, who recently resigned.

THE ONEIDA COMMUNITY, LTD., Oneida, N. Y., lists a line of weldless steel chains in a recent bulletin. A special folder is inclosed calling attention to the use of Oneida galvanized chains for arc-light suspension.

THE ROME WIRE COMPANY, Rome, N. Y., has mailed another one of its attractive series of monthly calendar post cards. The card carries an advertisement of bare and tinned copper wire, magnet and annunciator wire, etc.

THE ESTERLINE COMPANY, Lafayette, Ind., is distributing a new edition of perpetual catalog, section 1400 D, on portable and switchboard-type graphic meters, and section 1500 E, describing the matchless electric-lighting and ignition system for motor cars and boats.

THE CROCKER-WHEELER COMPANY, Ampere, N. J., has distributed a bulletin dealing with the subject of motor drive for printing machinery. Various features of economy and convenience are dealt with, and a number of illustrations of motor-driven presses are snown. A bulletin on electric hoisting machinery has also been issued.

THE DELTA-STAR ELECTRIC COMPANY, Chicago, Ill., manufacturers of high-tension specialties, has removed to 617-631 West Jackson Boulevard, where increased manufacturing and office facilities have been secured. In addition to high-tension devices a complete line of high-efficiency Mazda lighting units have been developed and will be placed on the market July 1.

THE GOULDS MANUFACTURING COMPANY, Seneca Falls, N. Y., has mailed circulars covering its new line of single-stage centrifugal pumps. These pumps are manufactured in both single and double suction types, either being designed so that it may readily be adapted to any other form of drive. The company announces that it will further develop this line and add additional sizes as the occasions demand.

THE TRIUMPH ELECTRIC COMPANY, Cincinnati, O., reports that the past month has been one of the most prosperous in the history of the company. Many orders for generators and motors have come in from various parts of the United States. The company also states that a great number of inquiries have been received from India, South Africa, New Zealand and South American countries during the past month.

THE ANSONIA BRASS & COPPER COMPANY, Ansonia, Conn., has mailed pamphlets descriptive of Tobin bronze and the uses to which it is put. The bronze is produced in the form of piston rods, shafting, rolled plates, tube sheets, flat, round and hexagonal bars, etc. The publication contains a number of letters of recommendations from various users of the company's product, and gives illustrations of some uses of the bronze.

THE KELLOGG SWITCHBOARD & SUPPLY COMPANY, Chicago, Ill., is issuing a complete catalog covering all the important items in standard telephone work. The catalog will enable prospective purchasers to obtain full information on anything from the smallest part of telephone apparatus to a complete exchange. A comprehensive index is provided so that any desired item may be found in a short space of time. The publication has a large number of illustrations.

THE GENERAL ELECTRIC COMPANY, Schenectady, N. Y., has recently issued bulletin No. 4848, describing its new combination ammeter and voltmeter. This instrument is inclosed in a dust-proof and moisture-proof aluminum case, and is designed to withstand the constant vibration and exposure incident to service on electric vehicles. The publication contains dimension and connection diagrams, and illustrations in actual size of the scales. Bulletin No. 4833 describes a number of installations of electrically operated gold dredges, and contains information which should be of great interest to all connected in any way with this industry. Bulletin No. 4851 contains data relative to the use of electricity in the service of steam roads. The publication comprises forty-eight pages which illustrate and describe both station and road equipment of the New York Central & Hudson River Railroad, the Detroit tunnel of the Michigan Central road, the Cascade tunnel of the Great Northern Railway, the equipment of the Baltimore & Ohio Railway, the West Jersey & Seashore, the West Shore Railroad, etc. In bulletin 4836 the company's flow meters are described. Two forms of the steam-flow meters are manufactured; one for recording and the other for merely indicating the flow. This meter resembles somewhat the air and water meters manuufactured by this company. Bulletin No. 4834 contains a description of the Detroit River tunnel.

DATES AHEAD.

National Electrical Contractors' Association. Niagara Falls, N. Y., July 19-21.

Ohio Electric Light Association. Annual convention. Cedar Point, O., July 25-28.

International Association of Municipal Electricians. Annual convention, St. Paul, Minn., September 12-15.

International Municipal Congress and Exposition. Chicago, Ill., September 18-30.

American Electrochemical Society. Twentieth general meeting, Toronto, Canada, September 21 to 23.

American Mining Congress. Thirteenth annual meeting, Chicago, Ill., September 25-30.

American Electric Railway Association. Annual convention, Atlantic City, N. J., October 9-13.

Association of Railway Electrical Engineers. Annual convention, La Salle Hotel, Chicago, November 6-10.

Directory of Electrical and Allied Engineering and Scientific Societies

(Published in the second issue of each month.)

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AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE. Secretary, L. O. Howard, Smithsonian Institution, Washington, D. C.

AMERICAN ELECTRIC RAILWAY ASSOCIATION. Secretary, H. C. Donecker, 29 West Thirty-ninth Street, New York, N. Y. Affiliated societies: American Electric Railway Accountants' Association, secretary, H. E. Weeks, Davenport, Iowa; American Electric Railway Claim Agents' Association, secretary, B. B. Davis, Columbus Railway & Light Company, Columbus, O.; American Electric Railway Engineering Association, secretary, Norman Litchfield, New York, N. Y.; American Electric Railway Transportation and Traffic Association, secretary, H. C. Donecker, 29 West Thirty-ninth Street, New York, N. Y.; American Electric Railway Manufacturers' Association, secretary, George R. Keegan, 2321 Park Row Building, New York, N. Y.

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AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Secretary, Ralph W. Pope, 29 West Thirty-ninth Street, New York, N. Y.

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AMERICAN RAILWAY MASTER MECHANICS' ASSOCIATION. Secretary, J. W. Taylor, Old Colony Building, Chicago, Ill.

AMERICAN ROENTGEN-RAY SOCIETY. Secretary, G. C. Johnson, 514 Bijou Building, Pittsburg, Pa.

AMERICAN SOCIETY FOR TESTING MATERIALS. Secretary, Edgar Marburg, University of Pennsylvania, Philadelphia, Pa.

AMERICAN SOCIETY OF ENGINEER DRAFTSMEN. Secretary, Harry L. Slogan, New York, N. Y.

AMERICAN SOCIETY OF ENGINEERING CONTRACTORS. Secretary, Julius R. Wemlinger, 626 Park Row Building, New York, N. Y.

AMERICAN SOCIETY OF CHEMICAL ENGINEERS. Secretary, John C. Olsen, Polytechnic Institute, Brooklyn, N. Y.

AMERICAN SOCIETY OF CIVIL ENGINEERS. Secretary, Charles Warren Hunt, 220 West Forty-seventh Street, New York, N. Y.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Secretary, Calvin W. Rice, 29 West Thirty-ninth Street, New York, N. Y.

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AMERICAN SUPPLY AND MACHINERY MANUFACTURERS' ASSOCIATION. Secretary, F. D. Mitchell, 309 Broadway, New York, N. Y.

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CENTRAL ELECTRIC TRAFFIC ASSOCIATION. Secretary, J. T. Brittson, Chicago, South Bend & Northern Indiana Railway Company, South Bend, Ind.

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ELECTRIC VEHICLE AND CENTRAL STATION ASSOCIATION. Secretary, H. T. Sands, 133 Pleasant Street, Malden, Mass.

ELECTRIC VEHICLE ASSOCIATION OF AMERICA. Secretary, C. E. Firestone, Columbus Buggy Company, Columbus, O.

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ELECTRICAL CREDIT ASSOCIATION OF CHICAGO. Secretary, Frederic P. Vose, 1343 Marquette Building, Chicago, Ill.

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FRANKLIN INSTITUTE. Secretary, R. B. Owens, 15 South Seventh Street, Philadelphia, Pa.

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WESTERN SOCIETY OF ENGINEERS. Secretary, J. H. Warder, Monadnock Block, Chicago, Ill.
WIRELESS INSTITUTE. Secretary, Sidney L. Williams, Room 1909, 42 Broadway, New York, N. Y.
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WISCONSIN STATE TELEPHONE ASSOCIATION. Secretary, Paul J. Weirich, Monroe, Wis.

RECORD OF ELECTRICAL PATENTS.

Issued (United States Patent Office) June 27, 1911.

996,068. ELECTRIC SNAP-SWITCH Conrad J. Dorff, Chicago, Ill., assignor to Harvard Electric Co., Chicago, Ill. Filed Oct. 3, 1910. A double-button flush wall switch includes a rock lever, knife-blade contacts and a compression spring.

996,069. TRAIN-INDICATING APPARATUS. Julian B. Edings, Macon, Ga. Filed Sept. 20, 1909. Renewed Nov. 9, 1910. A clock with hour and minute hands has a separate station pointer in front of the dial. The time hands and the pointer are separately electrically actuated from a distance.

996,088. COMBINED WIRE AND WIRELESS TELEPHONE SYSTEM. Maurice Bernays Johnson, San Antonio, Tex. Filed Oct. 6, 1910. Associated with the ordinary equipment of a telephone station is a switch by which the line may be connected to a central exchange or to a wireless system.

996,089. COMBINED WIRE AND WIRELESS TELEGRAPH SYSTEM. Maurice Bernays Johnson, San Antonio, Tex. Filed Oct. 6, 1910. Comprises wireless sending instruments including a circuit-breaking device, wireless receiving instruments, other wireless instruments located at a distance from the first instruments and means controlled from the distant sending instruments for operating the circuit-breaking device.

996,090. WIRELESS-TELEPHONE SYSTEM. Maurice Bernays Johnson, San Antonio, Tex. Filed Oct. 6, 1910. Includes a bell, a battery, two ground connections, a two-pole switch adapted to connect either bell or battery in circuit with the ground connections, or to break both the circuits, a switch for controlling the last named circuit, and a telephone instrument connected with the system but the circuit through which is normally broken.

996,091. SPARK-GAP MUFFLER. Maurice Bernays Johnson, San Antonio, Tex. Filed Oct. 6, 1910. An adjustable spark gap has its terminals passing through two end plates between which are several concentric glass cylinders.

996,092. BOX FOR CARRYING WIRELESS SIGNALING APPARATUS. Maurice Bernays Johnson, San Antonio, Tex. Filed Oct. 6, 1910. Comprises a box provided with a handle and a slotted top hinged thereto, a platform secured in the top of the body, reels secured to the platform, and metallic pegs secured to the ends of the conductors, and the body being provided with pockets on the outer sides thereof for containing the pegs.

996,094. METHOD OF MAKING FUSIBLE COMPOUNDS OF ALUMINUM AND RECOVERING ALUMINUM THEREFROM. Lucius Richard Keogh, Ottawa, Ontario, Canada, assignor of one-half to Clifton Ashton Douglas, Ottawa, Canada. Filed Aug. 22, 1908. Consists in adding anhydrous sulphate of aluminum to a molten bath containing a deoxidized compound of a metal more electro-positive than aluminum, and then passing an electric current through the mass to effect reduction and the production of a fusible aluminum compound.

996,120. SIGNALING ATTACHMENT FOR SPEEDOMETERS. William J. Norton, Denver, Colo., assignor of one-half to Hamilton Armstrong, Denver, Colo. Filed Aug. 4, 1909. Includes an electric alarm whose circuit is closed by the pointer of the dial.

996,143. COMMON-BATTERY LOCK-OUT TELEPHONE SYSTEM. Homer J. Roberts, Evanston, Ill., assignor to Homer Roberts Telephone Co., Chicago, Ill. Filed Oct. 22, 1908. A lock-out relay controlling the transmitter circuit has two windings opposing each other when current passes through both in series.

996,176. CASH-REGISTER. Byron B. Wells, Columbus, O., assignor to Standard Machine Manufacturing Co., Columbus, O. Filed Aug. 26, 1909. Opening of the cash drawer closes the circuit of an incandescent lamp.

996,204. FIBER FASTENING FOR INSULATED RAIL-JOINTS. Bancroft G. Braine, New York, N. Y., assignor to Rail Joint Co., New York, N. Y. Filed Feb. 23, 1909. An angle shoe extends beneath the rail base and is insulated therefrom by a sheet of fiber which is bent upwards along the edge of the rail flange and fits into a recess in the shoe.

996,218. BRUSH-HOLDER SUPPORT. Clarence T. Crocker, Norwood, O., assignor to Bullock Electric Manufacturing Co. Filed June 5, 1905. The support has an inclined recess into which fits a stud passing into the motor casing.

996,224. ADVERTISING-SIGN. Oliver C. Dennis, Chicago, Ill., assignor to Venn Manufacturing Co., Chicago, Ill. Filed June 26, 1909. A rotatable display drum is operated by an electromagnet through its armature and a pawl.

996,253. DYNAMO-ELECTRIC MACHINE. Frederic Ayers Johnson, Colorado Springs, Colo. Filed Jan. 9, 1911. Has a variable air gap obtained by jointly shifting circular wedges along the eccentric pole faces.

996,266. THREE-WIRE DYNAMO-ELECTRIC MACHINE. Charles E. Lord, Milwaukee, Wis., assignor to Allis-Chalmers Co. Filed June 7, 1909. Combined with the rotor is a commutator, rings provided with annular grooves mounted on the commutator, fans mounted on the rings, and reactance coils occupying the annular grooves.

996,267. ELECTRICALLY-OPERATED HOISTING APPARATUS. Frank Edward Lutz, Philadelphia, Pa. Filed June 8, 1909. A knife blade is connected flexibly to an arm so it can oscillate suddenly from one to an opposite set of contacts.

996,268. INCANDESCENT LAMP. Donald G. MacDonald, Sydney, Nova Scotia, Canada, assignor of one-fourth to Adelard La Pierre, Sydney, Canada. Filed July 11, 1910. The combination of a bulb, a tubular non-conducting support therein ,a number of conducting bands on the support, conducting arms radiating from the bands, filaments secured to and extending between the arms, and line conductors connected with the bands.

996,270. STATOR-COIL SUPPORT. Emil Mattman, Norwood, O., assignor to Allis-Chalmers Co. and Bullock Electric Manufacturing Co. Filed Jan. 31, 1907. Bracing and supporting means are provided to aid in the mutual bracing of the end turns of the two overlapping groups of coils.

996,273. FUSE-HOLDER. Robley C. Millard, Atlanta, Ga. Filed Feb. 19, 1910. The case has a lid on a side opening to give access to the fuse. Internal jaws hold the fuse.

996,279. ALARM. Jay A. Robinson, Denver, Colo. Filed Mar. 2, 1908. Beneath a telephone switch-hook is an electromagnet adapted to draw the hook down when energized. Release of the hook sets off an electric alarm.

996,280. HIGH-TENSION DISCHARGE APPARATUS. Edgar J. Rose, Los Angeles, Cal. Filed June 28, 1909. Includes an electromagnetic circuit controller and a discharge circuit containing a condenser and high-tension transformer.

996,303. SCREWLESS SPRING CONTACT. Henry Wilhelm, New York, N. Y. Filed Feb. 18, 1909. A push button has a looped spring contact which clamps itself to the back and holds a lead wire to the back.

996,312. INSULATOR. Thornten D. Childress, Ansted, W. Va. Filed Sept. 27, 1910. Consists of a base and somewhat narrower cap, the latter having in its outer face a groove transverse to the line wires for receiving a U-bolt that holds the parts in place.

996,331. PROJECTOR-CONTROLLER. John L. Hall, Schenectady, N. Y., assignor to General Electric Co. Filed Dec. 14, 1908. Combined with a projector are electric motors for training the same in altitude and azimuth, controlling means for the motors, a sight bar, and electrical means responsive to the movement of the sight bar for operating the controlling means.

996,334. DRIVING DYNAMOS FROM VARIABLE AND NON-VARIABLE SOURCES OF POWER. Caryl D. Haskins, Schenectady, N. Y., assignor to General Electric Co. Filed Aug. 5, 1908. A generator arranged to maintain a fairly constant potential is driven by a windmill or a gasoline engine. If the windmill speed is too low, it is uncoupled and the engine automatically started up. If the windmill speed is high enough, it is coupled up and the engine uncoupled and stopped.

996,335. FIRE-PROTECTION DEVICE. Richard B. Hewitt and James G. Nolen, Chicago, Ill.; said Nolen assignor of one-half of his right to Frank B. Cook, Chicago, Ill. Original application filed May 29, 1903. Divided and this application filed Apr. 6, 1907. Combined with a liquid receptacle is a bi-polar magnet having its poles projecting through the receptacle, an armature pivoted within the receptacle for movement in the plane of the magnet into or out of contact with its poles, an armature pivoted without the receptacle, and signaling means controlled by the second armature.

996,336. CIRCUIT-CONTROLLING SWITCH. Charles H. Hill, Schenectady, N. Y., assignor to General Electric Co. Filed Jan. 13, 1909. A resistance-short-circuiting switch is arranged like a double-throw switch, but has a larger number of contact clips of different lengths arranged alternately along both sides of the knife blade so as to contact with them one after another.

996,344. ELECTRICALLY-CONTROLLED SAFETY APPLIANCE FOR RAILWAYS. Richard T. Jones and Frank T. Jones, Baltimore, Md. Filed Oct. 15, 1909. Renewed Sept. 20, 1910. Associated with the contact shoe of a third-rail car is a steam pipe arranged to blow steam on the rail head when the shoe is lifted by ice.

996,350. HOT-WATER BOTTLE. Dumont P. Lamb, Portland, Ore. Filed Sept. 21, 1910. Has a chamber for the reception of an electric light bulb and socket.

996,371. VAPOR ELECTRIC APPARATUS. William F. Sneed, Schenectady, N. Y., assignor to General Electric Co. Filed Sept. 11, 1908. Comprises an inductance coil, a load circuit, a starting circuit, and a temporary connection between the starting circuit and an intermediate point on the inductance coil.

996,372. SYSTEM OF ELECTRICAL DISTRIBUTION. Charles P. Steinmetz, Schenectady, N. Y., assignor to General Electric Co.

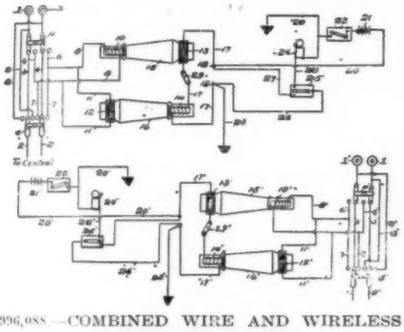
Filed Oct. 25, 1905. A mercury-vapor rectifier has a number of main anodes, and a mercury cathode and a starting anode, the latter being in contact when the device is not operating, a solenoid in circuit with a main anode and the starting anode, for separating the cathode and auxiliary anode and also maintaining the same separated after the starting arc has been broken.

996,373. OSCILLATING ELECTRIC SWITCH. George E. Stevens, Lynn, Mass., assignor to General Electric Co. Filed Aug. 20, 1909. A switch blade is actuated by a spring so that the movement of a laterally sliding button pushes a spring to one side of the dead center operating the switch in that direction.

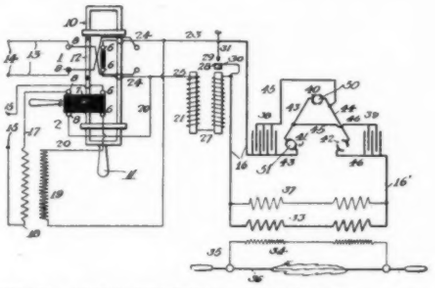
996,374. SOLDERING-MACHINE. Alfred Swan, Upper Montclair, N. J., assignor to General Electric Co. Filed Sept. 18, 1907. The lamp base and leading-in wire are held in engagement with each other and automatic means are provided for dropping a predetermined amount of molten solder upon the junction of the base and the leading-in wire.

996,376. NEUTRALIZING INDUCTIVE DISTURBANCES. John B. Taylor, Schenectady, N. Y., assignor to General Electric Co. Filed July 28, 1906. Disturbance between an aerial conductor and an inducing adjacent parallel conductor carrying an alternating current, are neutralized by a condenser, one terminal of which is connected with the first conductor and the other terminal of which is connected with a source of potential always in opposition to the potential of the inducing conductor.

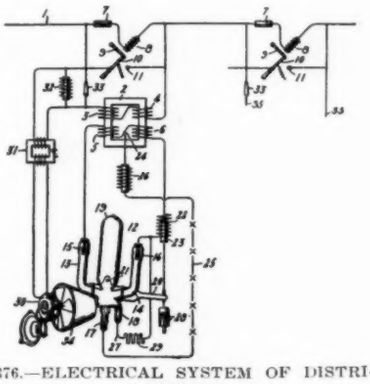
996,377. ELECTRIC MEASURING INSTRUMENT. Elihu Thomson, Swampscott, and Robert Shand, Lynn, Mass., assignors to General Electric Co. Filed Dec. 12, 1906. Comprises a magnet, pole pieces on the magnet arranged to produce two concentric annular fields, a moving element comprising a damping cylinder mounted to rotate in one of the annular fields, a current-carrying coil mounted on the cylinder to cut the flux in both of the annular fields, and means for furnishing the counter-torque for the moving element.



996,088.—COMBINED WIRE AND WIRELESS TELEPHONE SYSTEM.



996,280.—HIGH-TENSION DISCHARGE APPARATUS.



996,376.—ELECTRICAL SYSTEM OF DISTRIBUTION.

996,379. REGULATOR FOR STORAGE BATTERIES. Allen A. Tirrill, Schenectady, N. Y., assignor to General Electric Co. Filed Dec. 14, 1907. A booster with a separately excited field coil and an opposing field coil develops maximum voltages in opposite directions at predetermined upper and lower limits of voltage on the exciting circuit, and an electromagetic regulator varies the voltage on the circuit between the predetermined limits.

996,381. MAGNETIC SHIELD FOR ELECTRIC MACHINES. Henry H. Wait, Chicago, Ill. Filed Feb. 11, 1907. Laminated iron shields carried by the armature project beyond the surface of it between the central or active portion of the armature and each of the ends, the shields projecting between the edges of the magnet poles of the machine and the end connections so that the magnetic leakage is practically diverted from its path through the end-connections.

996,387. SWITCH FOR ELECTRIC CIRCUITS. Gilbert Wright, Pittsfield, Mass., assignor to General Electric Co. Filed Nov. 8, 1904. Comprises a contact having a flat bearing surface, a cylindrical socket, and a ball-shaped protuberance carried by the contact and fitted within the socket to slide longitudinally and to permit the contact to rock about the protuberance.

996,388. MOTOR-CONTROLLING DEVICE. Carl Eduard Zix, Berlin, Germany, assignor to General Electric Co. Filed March 27, 1908. A motor having a field winding for each direction of rotation, has means of control comprising a plurality of two-position interrupting switches normally in series with each other, and a double-pole reversing switch one element of which is connected with the fields alternately and the other element connected alternately with the shifted positions of the interrupting switches.

996,390. MOTOR CONTROL. Ernst F. W. Alexanderson, Schenectady, N. Y., assignor to General Electric Co. Filed Jan. 5, 1910. An auxiliary source of voltage is inserted in series with the motor field without breaking the series connection between motor field and armature. The motor field and auxiliary source of voltage are shunted by a resistance, and the voltage of the auxiliary source is varied to control the braking effect.

996,391. REINFORCER FOR TELEPHONE-CIRCUITS. Ernst F. W. Alexanderson, Schenectady, N. Y., assignor to General Electric Co. Filed Jan. 6, 1910. Comprises an inductor alternator having a winding common to its field and armature circuits, the field circuit being conected to the telephone circuit and the armature circuit being tuned approximately to resonance.

996,392 ARC-LAMP. Joseph H. Allen, Chicago, Ill., assignor to General Electric Co. Filed May 16, 1910. The arc-controlling magnet is short circuited by a rocking lever, actuated by a pair of thermostat rods.

996,393. CIRCUIT-BREAKER. Charles C. Badeau and Isaac F. Badeau, Bethlehem, Pa., assignors to Roller-Smith Co., New York, N. Y. Filed Dec 10, 1906. Has an underload armature and an auxiliary armature adapted to mechanically engage therewith under no load.

996,394. SWITCH OR CIRCUIT-OPENER FOR HIGH-POTENTIAL CIRCUITS. Charles C. Badeu, Bethlehem, Pa., assignor to Roller-Smith Co., New York, N. Y. Filed Aug. 8, 1908. Has a breaker, a constantly rotating shaft and a magnetic clutch thereon; connections between the clutch and breaker for controlling the latter, an electric circuit connected with said clutch. and a control for such circuit.

996,406. ELECTRIC WELDING-MACHINE. John L. Hall and Amandus Metzger, Schenectady, N. Y., assignors to General Electric Co. Filed April 1, 1907. Comprises means for producing an electric arc at the junction of the metals to be welded, mechanism whereby the arc is automatically moved over the junction and automatic feeding means for preventing interruption of the arc.

996,408. ELECTRIC-LIGHT SOCKET. Theodore E. Hamby, Rockwood, Tenn. Filed Feb. 14, 1911. Relates to details of construction.

996,410. SPARK-PLUG. Fred E. Harpst, Houston, Tex. Filed Oct. 27, 1910. Is provided with cooling fins, and an annular chamber so that air entering impinges on an insulator.

996,414. CONTROLLING SYSTEM FOR REVERSING-MOTORS. Samuel H. Keefer, Plainfield, N. J., assignor to Niles-Bement-Pond Co., Jersey City, N. J. Filed Nov. 2, 1910. A reversing switch is controlled by an electromagnet, in the circuit of which a resistance is retained until the speed of the motor has fallen below a predetermined point.

996,420. MANUFACTURE OF LAMP-FILAMENTS. John T. Marshall, Metuchen, N. J., assignor to General Electric Co. Filed May 22, 1908. The base is roughened by a reagent, prior to being flashed in the volatile hydrocarbon.

996,429. ARC-LAMP. Albert Schellenberger, Berlin, Germany, assignor to General Electric Co. Filed July 2, 1908. The downwardly converging electrodes of the lamp are moved together to compensate for the lengthening arc.

996,439. ELECTRIC HAMMER. Hilary F. Whalton, Key West, Fla. Filed Nov. 22, 1910. A case contains a stationary electromagnet and a slidable electromagnet. The contact is made and broken automatically by a tappet mechanism.

996,440. ELECTRIC HAMMER. Hilary F. Whalton, Key West, Fla. Filed Nov. 22, 1910. Similar to the preceding.

996,445. TELEPHONE RELAY AND SYSTEM. Ernst F. W. Alexanderson, Schenectady, N Y., assignor to General Electric Co. Filed Nov. 11, 1909. A high-frequency alternator has a winding serving as both field and armature windings, the winding being common to both of said circuits, and two portions of the winding being in series with respect to the primary circuit and in parallel with respect to the secondary circuit.

996,454. ELECTRIC HEATER. Adam Carpenter, Tacoma, Wash. Filed Nov. 12, 1910. An outer casing is provided with a steam chamber to which the heating units are adjacent. Current is switched on when the heater door is shut, and cut off when it is opened.

996,457. THRUST-BEARING. Walter M. Coffman, Madison, Wis., assignor to General Electric Co. Filed Feb. 27, 1906. A mem-

ber fastened to a vertical shaft of a dynamo-electric machine is provided with a horizontal bearing surface, a support for the shaft is also provided with a horizontal bearing surface, and a series of disks with their flat sides horizontal are arranged in a circle about the shaft and between the bearing surfaces.

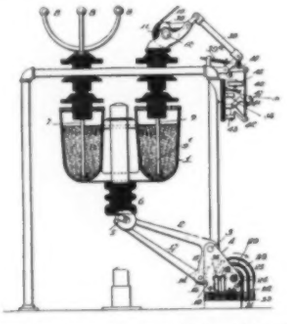
996,460. RETURN-INDICATION DEVICE FOR ELECTRIC INTERLOCKING SYSTEM. Fred B. Corey, Schenectady, N. Y., assignor to General Electric Co. Filed Sept. 24, 1908. Has an electric motor, a control lever therefor, a traffic controlling device, operative connections between the motor and device, a return indication circuit and means for producing a current in the circuit when the device is driven by the motor to a predetermined position.

996,475. BRUSH FOR DYNAMO-ELECTRIC MACHINES. Walter C. Fish, Lynn, Mass., assignor to General Electric Co. Filed Sept. 11, 1909. Has a metallic top which is provided with radiating vanes.

996,489. TELLTALE FOR ELECTRIC LIGHTS. James Frank Key, Washington, D. C. Filed Dec. 30, 1908. Comprises a primary incandescent electric lamp, a shunt around the lamp, and a telltale lamp in the shunt having a specific resistance such as to adapt it to burn dimly when the primary lamp is in normal condition.

996,491. MAGNETIC PREPARATION OF ORES. Alfred Arthur Lockwood, London, England, assignor to Murex Magnetic Co., Ltd., London, England. Filed April 14, 1911. The process consists in treating the ore with a magnetic substance, an oily liquid, and a solution of a sulfid of an alkali metal and magnetically separating the mixture.

996,492. ELECTRIC MELTING AND REDUCTION FURNACE. Hans Bie Lorentzen, Notodden, Norway. Filed April 20, 1911. A series of spaced independent channels are arranged to surround the upper eletcrode and have discharge ends disposed adjacent to the upper electrode.



996,394.—SWITCH FOR HIGH-TENSION CIRCUITS.

996,500. AUTOMATIC EXCHANGE SYSTEM. William Hugo Matthies, Antwerp, Belgium, assignor to Western Electric Co., New York, N. Y. Filed Nov. 12, 1910. The combination with variably adjustable circuit controlling devices, of a common controlling circuit, a resistance in the circuit, and means whereby the devices are adjusted in response to resistance changes in the circuit and are switched by the opening of the circuit.

996,501. ELECTRIC-ARC LAMP. Louis Carl Henry Mensing, Edinburgh, Scotland. Filed Oct. 28, 1910. A magazine for containing arc lamp carbons is provided at its upper and lower ends with tracks inclined downwardly toward one of its vertical edges, and with a feed tube located at the foot of the edge. A ball is arranged to travel along each of the tracks for pressing the carbons in position to feed through the tube.

996,529. SYSTEM OF MOTOR CONTROL. Willard T. Sears, Philadelphia, Pa., and Samuel H. Keefer, Plainfield, N. J., assignors to Niles-Bement-Pond Co., Jersey City, N. J. Filed Oct. 28, 1910. Comprises an electric motor, electromagnetic mechanism for controlling the same, a pilot switch for governing the mechanism, a second motor also controlled by the mechanism, and a switch actuated by the second motor for governing its operation.

996,536. LUBRICATED BEARING. Peter Smith Swan, Calcutta, India. Filed June 14, 1910. Oil chambers are arranged for lubricating the shaft of a vertical motor.

996,551. ELECTRICALLY-CONTROLLED CLOCK AND TIME-INTERVAL TRANSMITTER. Harold Isaac Aiken, San Francisco, Cal. Filed Dec. 9, 1909. Renewed Dec. 7, 1910. A rocker arm controlled by the escapement of the controlling clock makes contact with mercury cups. The impulse is transmitted to the escapement of the controlled clock.

996,560. APPARATUS FOR PURIFYING WATER BY OZONE. Charles S. Bradley, New York, N. Y., assignor to Richard B. Wilson, New York, N. Y. Filed June 19, 1905. The ozone in contact with the water is compressed by mechanical means.

996,561. OZONIZING AND COMPRESSING PROCESS. Charles S. Bradley, New York, N. Y., assignor to Richard B. Wilson, New York, N. Y. Original application filed June 19, 1905. Divided and this application filed Dec. 4, 1905. Similar to the preceding.

996,571. DYNAMO-ELECTRIC MACHINE. Edgar A. Edwards, Cincinnati, Ohio, assignor to Schroeder Headlight Co. Filed Nov. 30, 1901. The laminations of the field magnets are made in a double T shape, the two parts of which may be keyed together.

996,579. ELECTRICAL CONDUCTOR. Henry Geisenhöner and Fred L. Stone, Schenectady, N. Y., assignors to General Electric Co. Filed March 1, 1905. A portion of tubular metal is inserted in a hole in a carbon brush, and the tube and carbon are electroplated.

996,580. WIRELESS TELEGRAPHY. Charles M. Green, Lynn, Mass., assignor to General Electric Co. Filed Sept. 30, 1907. A method of simultaneously transmitting two or more distinct wireless signals, which consists in causing the emission of two or more trains of electromagnetic waves of different periodicities in multiphase current time relation, and breaking each train independently into groups in accordance with a code.

996,582. STATIC PROTECTOR FOR VAPOR ELECTRIC APPARATUS. Joseph L. R. Hayden, Schenectady, N. Y., assignor to General Electric Co. Filed Jan. 5, 1906. Combines an exhausted envelop, electrodes therefor one at least of which is of vaporizable material, and means for rendering the entire space about a given electrode of the same potential as the electrode itself.

996,583. ELECTROLYTE FOR ELECTROLYTIC CELLS. Joseph L. R. Hayden, Schenectady, N. Y., assignor to General Electric Co. Filed March 4, 1908. Combines aluminum electrodes and an electrolyte consisting of a substantially neutral solution of ammonium octoborate.

PATENTS THAT HAVE EXPIRED.

Following is a list of the electrical patents (issued by the United States Patent Office) that expired July 3, 1911:

522,189. ELECTRIC-RAILWAY-CAR TRUCK. Francis O. Blackwell, Lynn, Mass.

522,216. WIRE-SUPPORT FOR OVERHEAD ELECTRIC RAILWAYS. Arthur W. Jones, Boston, Mass.

522,232. ELECTRIC SAFETY FUSE. Joseph Sachs, New York, N. Y.

522,233. ELECTRIC-ARC LAMP. Albert Schweitzer, Allegheny, Pa.

522,241. ALTERNATING-CURRENT DYNAMO MACHINE. Elihu Thomson, Swampscott, Mass.

522,274. DYNAMO-ELECTRIC MACHINE. Charles E. Scribner, Chicago, Ill.

522,275. REGULATOR FOR DYNAMO-ELECTRIC MACHINES. Cnarles E. Scribner, Chicago, Ill.

522,276. ELECTRIC-ARC LAMP. Albert W. Smith, San Francisco, Cal.

522,286. DYNAMO-ELECTRIC MACHINE OR MOTOR. Charles S. Bradley, Avon, N. Y.

522,294. ELECTRIC-ARC LAMP. Edward Heyman and Frank W. Heyman, Boston, Mass.

522,302. SELF-LOCKING CLEAT FOR ELECTRIC WIRES. Elias Nashold, Chicago, Ill.

522,327. ELECTRIC-ARC LAMP. Jesse F. Kester, Buffalo, N. Y.

522,332. ELECTRIC SWITCH. John Van Vleck, New York, N. Y.

522,345. METHOD OF PRODUCING CONTINUOUS MOTION BY ALTERNATING CURRENTS. John F. Kelly, Pittsfield. Mass.

522,349. RAIL JOINT AND BOND FOR ELECTRIC RAILWAYS. Julius Meyer, New York, N. Y.

522,352. ELECTRICAL FISHING APPARATUS. Edward Poppowitch, Brooklyn, N. Y.

522,370. DISTRIBUTING BOARD FOR ELECTRIC CURRENTS. Reinhold Herman, Crafton, Pa.

522,374. ELECTRIC RAILWAY SUPPLY CIRCUIT. Rudolph M. Hunter, Philadelphia, Pa.

522,388. ELECTRIC-RAILWAY SWITCH AND TROLLEY. Frederick S. Perrin, Lynn, Mass.

522,404. TELEPHONE-TRANSMITTER. William R. Cole, Detroit, Mich.

522,431. ELECTRIC-ALARM SIGNAL FOR RAILWAY CROSSINGS. James J. Ross, Detroit, Mich.

522,440. CONDUIT ELECTRIC RAILWAY. John H. Tyrrell, New York, N. Y.

522,460. ELECTRIC-RAILWAY CONDUIT. Albert T. Fay, Minneapolis, Minn.

522,461. CONDUIT FOR TROLLEY-ARMS. Albert T. Fay, Minneapolis, Minn.

522,479. ELECTRODE FOR SECONDARY BATTERIES. William Morrison, Des Moines, Iowa.

522,506. ELECTRIC CONVERTER. George D. Burton, Boston, and Edwin E. Angell, Somerville, Mass.

522,507. ELECTRIC CONVERTER. George D. Burton, Boston, and Edwin E. Angell, Somerville, Mass.

522,527. ELECTRIC AUTOMATIC CIRCUIT BREAKER. Carl W. Larson, Lynn, Mass.

522,528. ELECTRIC TORPEDO APPARATUS AND SYSTEM FOR RAILWAY SIGNALING. Jacob W. Lattig, Easton, Pa.

522,564. MULTIPLE TELEPHONY. Maurice Hutin and Maurice Leblanc, Paris, France.